New York State Museum Bulletin

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No. 321 ALBANY, N. Y. April 1940

NEW YORK STATE MUSEUM

CHARLES C. ADAMS, *Director*

THE PRIMEVAL FOREST TYPES OF SOUTHWESTERN NEW YORK

BY ROBERT B. GORDON Ph.D., *Temporary Botanist*
New York State Museum

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LIST OF ILLUSTRATIONS

THE PRIMEVAL FOREST TYPES OF SOUTHWESTERN NEW YORK

By Robert B. Gordon Ph.D., *Temporary Botanist*
New York State Musuem

INTRODUCTION

OBJECT OF THIS STUDY

All the early historical writers of America seem to have lacked information regarding the character of the great forests that covered the Eastern States. Descriptions of town and village sites, pioneer industries, commerce and wars fill their histories, but few and fragmentary are their accounts of the primeval forest.

"In 1609 Henry Hudson explored the Hudson river. He 'went on Land . . . and found . . . great store of goodly Oakes, and Walnut trees, and Chestnut trees, Ewe trees, and of sweet wood in great abundance.' Samuel Champlain in the same year discovered Lake Champlain and merely remarked that it was surrounded by a number of fine trees 'similar to those we have in France.' When Robert Fallam and Thomas Batts crossed the Alleghenies in 1671, the only mention they made of trees was that they burned initials upon them." (Quoted from American Forests—Anniversary Number, September 1933.)

The present study is an attempt to reconstruct, as accurately as possible, the original vegetation of Cattaraugus county, to compare the present with the past, and to make some recommendations for land use and further scientific studies in a region remarkably rich in natural features. This is one aspect of a general comprehensive study of the vegetation and flora of the region carried on by the New York State Museum. It is an outgrowth of the detailed study and interpretation of the vegetation in the Allegany State Park (Taylor, '28; Gordon, Kenoyer, Emerson, Hicks and Saunders, '37). For the first time, the data obtained from the original Holland Land Company survey begun 140 years ago have been plotted on topographic maps and have served as a guide in the preparation of the vegetation map (in pocket).

LOCATION AND TOPOGRAPHY

Cattaraugus county is located in the southern tier of counties in western New York which borders Pennsylvania on the 42d parallel (figure 1). It is approximately 40 miles in length from east to west and about 36 miles in width from north to south. Its total land area, as given in the 1930 census, is 1343 square miles. According to Fenneman's map (1928) the entire county lies within

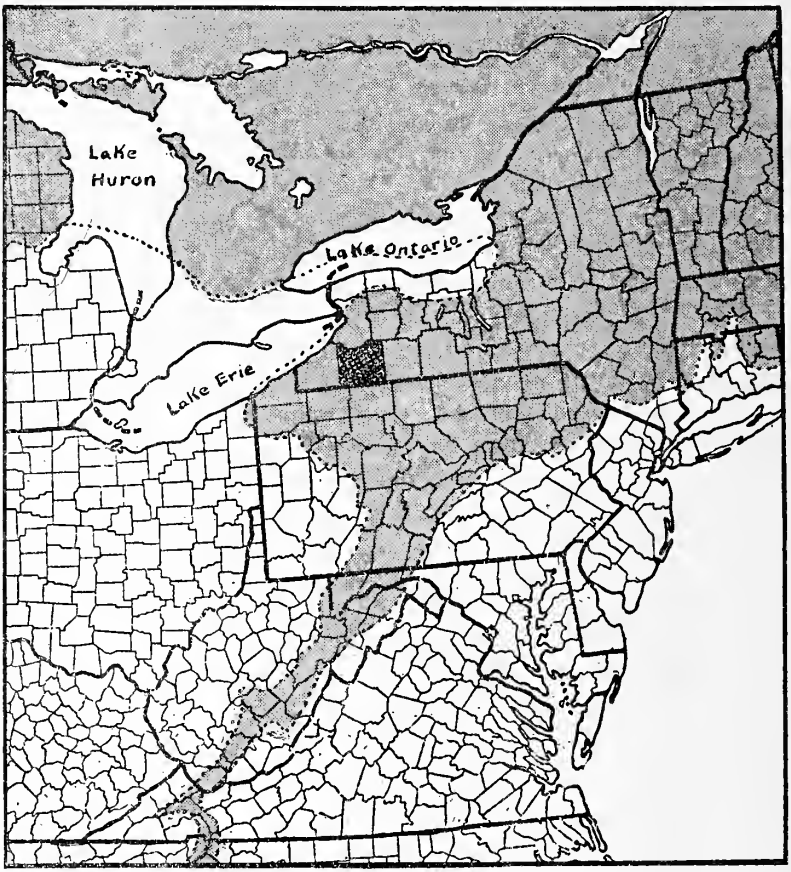

Figure 1 Map showing the location of Cattaraugus county, N. Y., in relation to the Hemlock–White Pine–Northern Hardwood Region (shaded portion)

the Kanawha section and the southern New York section of the Appalachian Plateau physiographic province. The southern New York section corresponds to the glaciated portion and the Kanawha section to the unglaciated. The Kanawha section reaches an altitude

of 2400 feet, which is approximately 1000 feet above the level of the Allegheny river. The contrast between the glaciated and unglaciated country is most striking (figures 3 and 4). The variations in forest cover and soil conditions in the region can largely be explained on the basis of relative relief and topography, and the best croplands are in the valleys and glaciated portions of the county.

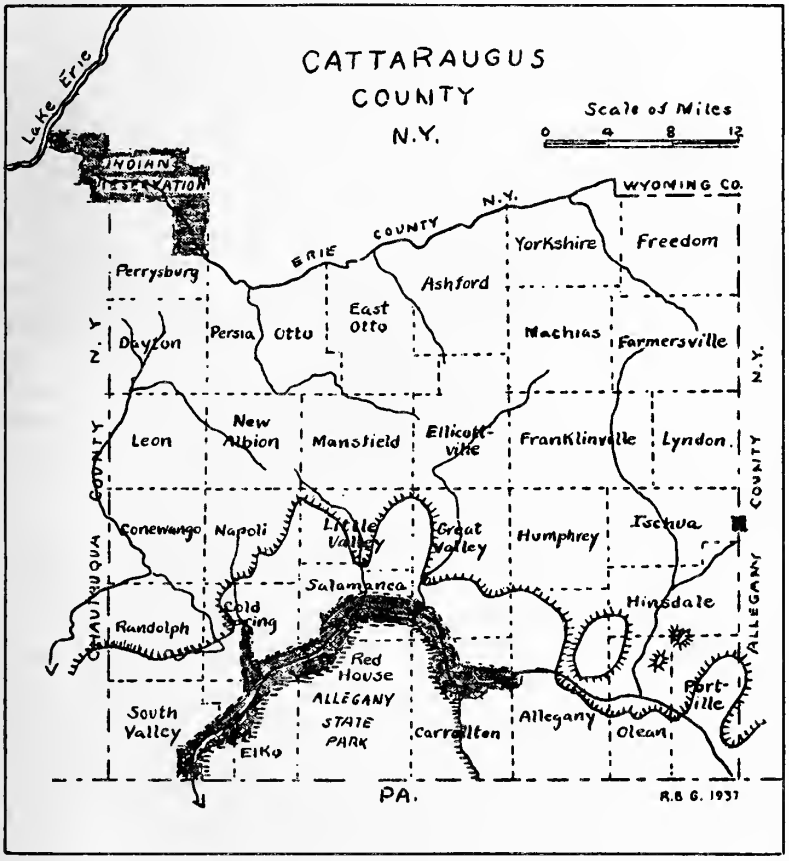

Figure 2 The glacial boundary in Cattaraugus county, N. Y., in relation to the townships

The name "Cattaraugus" is derived from a Seneca word meaning "bad-smelling banks," which refers to the odor of natural gas leaking from the bedding planes and joint planes, mostly in the Upper Devonian shales. These soft shales are easily eroded, producing spectacular gorges such as those along Cattaraugus creek and the South Branch near Gowanda (figures 5 and 6).

The county is drained by three major streams. Cattaraugus creek on the northern boundary empties into Lake Erie near Irving, two miles northeast of the town of Silver Creek. The central and southern portions are drained by the Allegheny river and a large tributary, Conewango creek, which flow southward and join at Warren, Pa. These streams are important upper tributaries of the Ohio river.

It can readily be seen that Cattaraugus county offers much diversity in topography and that important natural boundaries are established within the area. Within the county are the watersheds of two great river systems, the St. Lawrence and the Mississippi. Here also are gradation zones between the Allegheny peneplain and the Upland peneplain (Cole, '37). At least one great continental glacier here reached its limit of extent from the north, so that glaciated and unglaciated terrain are both represented. It will also be shown that a natural vegetation boundary exists here, which is critically important to the local naturalist. The natural vegetation of this region has reacted in various ways with the soils and native animal life of the county, its industries and the lives of its people, from the aboriginal inhabitants to the present. The importance of such a natural resource is scarcely appreciated by the average person, but is of great significance to the geographer (Mason, '36).

HISTORY OF BOTANICAL STUDIES IN THE REGION

Interest in the vegetation of this county dates back to the days of earliest settlement, perhaps to an aboriginal period. The forest and its soils furnished some American Indians and their predecessors poles and barks for their lodges, fuel for their fires, weapons and tools, and a number of food and medicinal plants. The earliest white settlers made crude potash or "black salts" by burning wood and leaching the ashes. The solution of lye thus obtained was boiled until it became a solid substance. This was one of the chief items which could be sold for ready cash in pioneer days (William Adams, '93).

When the land was purchased by Robert Morris from Indians in 1787 at the Treaty of the Big Tree, one of the first tasks confronting its new owners, the Holland Land Company, was to make a survey of their enormous holdings. Surveyors were employed to lay out the property into townships, lots and villages. In addition they made notes concerning the character and quality of the timber, which are of considerable interest today. These earliest surveys extended over the period between 1798 and 1809.

Figure 3 The unglaciated Allegheny plateau in the Allegany State Park

Figure 4 The glaciated valley of Beaver Meadows creek

Figure 5 Shale cliffs at Point Peter, near Gowanda

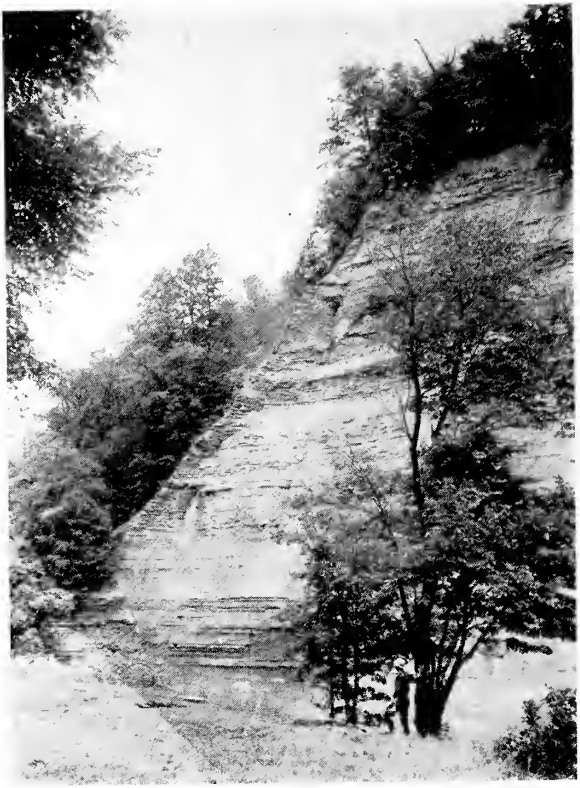

Figure 6 The Gowanda shales at Forty Bridge

The first plant collecting in Cattaraugus county of which there is a substantial record was done by Judge George W. Clinton, the first president of the Buffalo Society of Natural Sciences, organized December 5, 1861. Judge Clinton, David F. Day and Dr Charles C. F. Gay were appointed on a committee at that time to assemble a general herbarium of the plants of Buffalo and its vicinity. For 20 years Judge Clinton and his friend, David F. Day (also an attorney-at-law), collected plants of the region, coming as far south as Salamanca, in Cattaraugus county. It devolved upon Mr Day to prepare a catalog, The Plants of Buffalo and Its Vicinity, published in 1882 by the Buffalo Society of Natural Sciences. Mr Day continued to explore the local flora during the period from 1880 until 1900, the time of his death. Between 1900 and 1920 there was not much systematic study in the region, except by Dr Anne E. Perkins, who botanized alone on the Cattaraugus Indian Reservation (Zenkert, '34).

With the establishment of the Allegany State Park in 1921 further interest was aroused in the vegetation of the region. The Buffalo Society of Natural Sciences, under the presidency of Chauncey J. Hamlin, established a botanical section, which began field work the following year under the leadership of Frank W. Johnson, an accomplished amateur botanist. Chief contributors to botanical knowledge of the flora of Cattaraugus county since 1921 have been Frank W. Johnson; William P. Alexander, field naturalist of the Buffalo Society of Natural Sciences; Dr Anne E. Perkins, staff member of the Gowanda State Hospital; Dr Homer D. House, State botanist of the New York State Museum; Irving W. Knobloch, Charles A. Zenkert, Norman Taylor, Dr Leslie A. Kenoyer, Dr Fred W. Emerson, Dr Lawrence E. Hicks, Aretas A. Saunders and the writer.

The New York State Museum, under the direction of Dr Charles C. Adams, published two handbooks: The Flora of the Allegany State Park Region (House and Alexander, '27), and The Vegetation of the Allegany State Park Region (Taylor, '28). The Buffalo Society of Natural Sciences in 1934 published a bulletin, The Flora of the Niagara Frontier Region (Zenkert, '34) which includes most of the species of vascular plants found in Cattaraugus county. Several additions to the flora have been published by Irving W. Knobloch, who recently served as the state park naturalist. With the establishment of the Allegany School of Natural History in 1927, other botanists have continued studies in the State Park region under the auspices of the New York State Museum. The results

of their botanical ecological survey have recently appeared in Handbook 17 (Gordon and others, '37). These and other contributions to the botany of the region are listed in the bibliography.

Thus it will be seen that the vascular flora of Cattaraugus county, N. Y., has been rather thoroughly studied during the past 75 years. Upwards of 850 species of vascular plants have been recorded for this county, including both native and naturalized forms. Nevertheless, additions to the flora of the county have been made at the rate of eight or ten species a year. To be sure, many of these new additions consist of adventives and introduced weeds or newly recognized varieties. A few of the forms recorded to date may have been exterminated or are destined to disappear in the future.

USE OF PLANT NAMES

In the preparation of this bulletin, common names of plants are employed as much as possible. Common names are followed by scientific names where first used. Some plants, such as sedges and grasses without well-recognized common names, may be given only scientific names. Scientific names conform with those in the Annotated List of the Ferns and Flowering Plants of New York State (House, '24). In cases where scientific names deviate from those in House's list, the authority is stated. It is recognized, of course, that there is no standard authority for the use of common names, with one possible exception, the Check List of Forest Trees of the United States (Sudworth, '27), adopted by the United States Forest Service. In this bulletin *Betula lenta* is referred to variously as black birch, sweet birch and cherry birch.

PRIMARY VEGETATION DEFINED

The "forest primeval" in the popular mind is one of big trees, hundreds of years old, with towering trunks 50 or 75 feet to the first limb, forming a closed canopy and lending a cathedral atmosphere to the scene. Such forests in this country are outstanding examples of what we mean by "primary vegetation." This term applies to the original vegetation as it existed when Europeans first settled in the region. Another synonym is "virgin forest," implying one that has been undisturbed, for centuries at least, by human industry. It would be difficult to prove this point absolutely in any particular case. The American Indian had practised for centuries the burning of woods and "deadening" of timber to aid him in the hunt, to drive out poisonous snakes and to practise a primitive type of agriculture. It can scarcely be doubted that these practices had a profound effect on forest composition (Bromley, '35).

Figure 7 A "forest mound" marks the site of an ancient windfall

Figure 8 Oak-hickory "barrens" north of Onoville; once a "fine pinery"

The primeval forests of Cattaraugus county actually contained a good deal of what the surveyor, Joseph Ellicott, called second and third quality timber in 1799. In the land surveyor's notes on township 4, range 5, section 10, of the Holland Land Survey, the following statement appears: "There came on at 1 o'clock in the morning a tremendous hurricane, the trees fell in every direction. I was forced to seek shelter on the intervail where the timber was thin and low. July 5th, 1805." The effects of windfalls are everywhere present in the forests of the county, as shown by earthen mounds or hummocks, over which big trees are growing today (figure 7). It is possible for a virgin forest dominated by veteran white pines (*Pinus Strobus*) and hemlocks (*Tsuga canadensis*) to be altered overnight by a destructive tornado so that the timber remaining consists of half-grown beeches (*Fagus grandifolia*) and sugar maple (*Acer saccharum*), together with other inferior saplings. Thus the popular idea of a virgin forest must be modified to include woodlands not much better than good second-growth timber in which the dominants may average 50 to 100 years of age.

The high terrace along the Allegheny river between Quaker Bridge and Onoville was described in the surveyor's records as a "fine pinery." Here veteran white pines grew so large and so far apart that it was possible to drive a horse and shay through the forest, carpeted with pine needles and practically free of undergrowth. Going back into archeological history we find that generations before the white man entered this region the high terrace was a favorite village site of the aborigines. Today the "pinery" has vanished, as has all timber of any size in the Allegany Indian Reservation. This area has since burned over repeatedly until a veritable thicket has formed. The vegetation consists of a low growth of scrubby oaks and hickories, mixed with herbaceous plants that thrive in open "barrens" (figure 8).

For the purpose of this discussion we must limit our term "primary vegetation" to the natural forest cover as it existed in pioneer days, in this region about 1795. The primary vegetation of the high terrace must therefore go on record as a "pure stand" of white pine, although such stands were decidedly rare in this county originally. From the known behavior of white pine, it is highly probable that the "fine pinery" north of Onoville became established on what were once cultivated fields near an Indian village site.

ACKNOWLEDGMENTS

The preparation and publication of this bulletin are due to the efforts of Dr Charles C. Adams, Director of the New York State Museum. Doctor Adams has recognized the need for field studies of this type as fundamental to the understanding of the natural history of New York State. It is hoped that this work will serve as a model to be followed in ecological studies elsewhere in the state. To Dr E. N. Transeau and Dr H. C. Sampson, of the Department of Botany, The Ohio State University, the author is indebted for the development of methods used and for a knowledge of the principles of plant ecology which are here applied.

The field work has been done during the months of July and August, in 1934, 1935, 1936 and one month in 1937, while the author was employed as temporary botanist on the staff of the New York State Museum. Headquarters were established at the Allegany School of Natural History, which furnished a convenient working base. The author's associates, especially Aretas A. Saunders and William P. Alexander, have been most generous in supplying ecological data concerning the Allegany State Park region, in the southern portion of the county. Information about early forest conditions has been gleaned from various persons who have lived in the region for a long time. Among them are John M. Holt, of Quaker Bridge; W. J. Ryan, of West Valley; Mrs George Watson, of East Dayton; Charles F. Congdon, M. M. Moffat, and Irving J. Nies, of Salamanca; John J. Walker and Frank Waters, of Limestone. To his wife, Esther Loomis, the writer acknowledges assistance both in the field and in the preparation of the manuscript.

PRIMEVAL TRACTS IN CATTARAUGUS COUNTY

Although a great portion of the county is forested today, there are few areas that are relatively undisturbed and that might be termed samples of the primeval forest. One of these tracts is located in Allegany State Park and is known as the Big Basin tract. It is so fully described in Handbook 17 of the New York State Museum (Gordon and others, '37) that only a brief digest will be given here.

In Big Basin there is one large area of mature timber covering nearly 1300 acres around the headwaters of Stoddard creek. This tract has come to be generally known as "The Big Trees." Old settlers seem to agree that in the early days the white pine was removed as well as black cherry *(Prunus serotina)* and perhaps others of the more valuable trees (Emerson, '37).

Throughout the "Big Trees" area the species are largely beech, sugar maple, hemlock and yellow birch (*Betula lutea*). The latter two species predominate in the lower portion of the valley of Stoddard creek. There are occasional individuals of blue beech (*Carpinus caroliniana*), red maple (*Acer rubrum*), basswood (*Tilia americana*), white ash (*Fraxinus americana*), and cucumber tree (*Magnolia acuminata*) among the hemlocks and northern hardwoods. On the divide between Lonkto and Stoddard hollows is a small area, about 50 acres perhaps, in which such species as chestnut (*Castanea dentata*), white pine, black birch (*Betula lenta*), and red oak (*Quercus borealis* Michx.) enter the mixture. This association of forest trees differs decidedly from other forest types in the Big Basin and is probably an example of the Mixed Mesophytic Forest (Braun, '35*a*).

Another virgin forest tract in the Allegany State Park lies in upper Red House valley. The dominants and codominants on this moist site are hemlock, beech, yellow birch, red maple, black cherry and sugar maple. The "suppressed" trees and shrubs are all shade-tolerant and include sugar maple, beech, yellow birch, hop hornbeam (*Ostrya virginiana*) and hobblebush (*Viburnum alnifolium*). The ground cover of herbaceous plants consists largely of the following species:

Common wood fern	*Dryopteris spinulosa* var. *intermedia* (Underw.)
Common wood sorrel	*Oxalis Acetosella*
Shining club moss	*Lycopodium lucidulum*
False lily-of-the-valley	*Maianthemum canadensis* (Greene)
Foam flower	*Tiarella cordifolia*
Yellow clintonia	*Clintonia borealis*
Twisted-stalk	*Streptopus roseus*
Starflower	*Trientalis borealis*
Indian cucumber root	*Medeola virginiana*
Stemless yellow violet	*Viola rotundifolia*
Woodland white violet	*Viola incognita*

A remarkable area of nearly 400 acres known as the "Waterman Swamp" is located about three miles west of Little Valley, the county seat, and about two miles north of Pigeon Valley School, in Napoli township. It is shown near the bottom of the Cattaraugus quadrangle of the United States Geological Survey. Farmers in the region refer to part of it as "Owlenburg Bog" (miscalled "Allenberg," according to Charles E. Congdon of Salamanca). Ownership is divided among several adjoining farms. The bog and swamp occupy a low divide at the headwaters of Little Valley creek, Cold Spring creek and the Little Conewango creek.

The surrounding forests originally contained white pine, hemlock, beech, yellow birch, sugar maple, basswood, cucumber tree and white ash. The bog is now in an excellent state of preservation, and is a beautiful example of a type of vegetation that commenced its development at the time of the last Wisconsin glacier, nearly 40,000 years ago. The bog itself and land immediately adjoining contain primeval vegetation. The largest specimens of hemlock remaining here exceed in size those found in the Allegany State Park to the south and are the equals of those at Heart's Content and Cook Forest in Pennsylvania. During the past few years, 1934–36, inroads have been made on the virgin forest of hemlock and hardwoods, and unless the area is soon purchased by the State of New York, the last of these great trees may be harvested and this bit of primeval wilderness will be gone forever. The six illustrations (figures 9–14) give a fair idea of different aspects of the vegetation as it appears today.

The 400-acre bog covers a peat deposit formed by the decay of sphagnum moss and other bog plants for thousands of years. It is only because of this thick deposit of water-soaked peat that the bog vegetation has survived long periods of drought during its history. The low bog shrubs are principally leather-leaf or cassandra (*Chamaedaphne calyculata*) interspersed with bog rosemary (*Andromeda glaucophylla*), Labrador tea (*Ledum groenlandicum*), black chokeberry *(Aronia melanocarpa)* and sour-top blueberry (*Vaccinium canadense*). Most characteristic are the scattered and dwarfed conifers, seldom 20 feet high, which include tamarack (*Larix laricina*), black spruce (*Picea mariana*) and white pine. Wintergreen (*Gaultheria procumbens*), cranberries (*Oxycoccus* sp.) snowberries (*Chiogenes hispidula*) and moccasin-flowers (*Cypripedium acaule*) grow beneath the dense cover of bog shrubs. Near the margins of the bog are taller shrubs, including highbush huckleberry (*Vaccinium corymbosum*), mountain holly (*Nemopanthus mucronata*) and witherod (*Viburnum cassinoides*) beneath which are cinnamon ferns (*Osmunda cinnamomea*) as high as a man's shoulders (figure 15).

Two small ponds occur in the area, one near the western border of the swamp and another to the south. The latter is a little gem of the wilderness. The black pool of open water is about 50 yards in diameter, bordered with white water-lilies (*Castalia odorata*). This is surrounded by a sphagnum and cranberry bog meadow containing pitcher plants (*Sarracenia purpurea*), sundew (*Drosera rotundifolia*), yellow-eyed grass (*Xyris caroliniana*), cotton sedge (*species of Eriophorum*), buckbean (*Menyanthes trifoliata*) and some characteristic bog orchids.

Figure 9 Eastern portion of Waterman swamp from the Case farm

Figure 10 Western portion of Waterman swamp from the Case farm

Figure 11 Black spruces and tamaracks in Waterman swamp

Figure 12 "Black pond" in Waterman swamp, town of Napoli

Figure 13 A hemlock 45 inches in diameter at Waterman swamp

Figure 14 Undergrowth of *Rhododendron maximum* in the bog forest at Waterman swamp

Figure 15 Luxuriant growth of cinnamon ferns (*Osmunda cinnamomea*) on acid peat in the shade of the mature bog forest. Hemlock–Yellow Birch Association at Waterman swamp. Photograph by Richard B. Congdon

A zone of dwarf shrubs bordered by taller shrubs surrounds the bog meadow, and these are bordered by a conifer forest of black spruce, tamarack, hemlock and white pine, with some deciduous trees, mostly red maple and yellow birch. There is no poison sumach (*Rhus vernix*) or poison ivy (*Rhus toxicodendron*). Beneath the hemlocks are great rhododendron (*Rhododendron maximum*), tall cinnamon ferns and several mats of American yew (*Taxus canadensis*).

METHODS OF DETERMINING THE CHARACTER OF THE ORIGINAL VEGETATION

PRIMARY RECONNAISSANCE

To make a primary reconnaissance survey of the vegetation it is necessary to be acquainted with the species, especially the shrubs and trees and some herbaceous plants that compose the perennial flora. For rapid work, it is often important to recognize the trees at a considerable distance by shape, texture and color. Optical aids such as field glasses and spotting telescopes are of value for such observations. The dark green of oaks contrasts with the lighter green of maples and beeches. Species such as cucumber tree, white ash, and basswood reflect considerable white light and often stand out among their associates. Blighted chestnuts are remarkably conspicuous in summer due to their naked branches or masses of dead brown foliage. The two principal conifers of the region, white pine and hemlock, are easily told by their characteristic shapes. They are, of course, easiest to distinguish in the winter months.

The next step in reconnaissance is to visit primeval tracts or relatively undisturbed areas of natural vegetation and to determine the primary plant associations and their relations to environmental (principally edaphic) factors of the habitat. Some of these associations are fairly distinct and cover a wide area, and can be mapped on a small scale (one inch to one mile). The successional phases of the Deciduous Swamp Forest (Sampson, '30*a*) and segregates of the Mixed Mesophytic Forest can be mapped only on a large scale (6 to 12 inches to one mile) to show much detail. The most convenient maps for use in reconnaissance are the topographic sheets of the United States Geological Survey. A single quadrangle is a practical working unit. Modern soil maps published since 1910 are helpful and may be used to indicate unusual areas and certain natural boundaries of importance. These maps, however, must be used with a thorough knowledge of the principles upon which the

various soils series are classified. These may vary with different states. Frequently more than one vegetation type will be found on the same soil type and vice versa, as Sampson discovered in Marion county, Ohio ('30 *c* and *d*).

Reconnaissance mapping may be done in the field directly on the topographic sheets, if available, or on county road maps. For rapid work, an automobile is necessary, preferably one built for travel over unimproved roads. A cyclometer, graduated to tenths of a mile, is essential standard equipment for this purpose. A party of two, one to drive and one to map, can accomplish more than one person who tries to do both. Notations are made concerning existing stands of timber, using abbreviations as follows:

H-B—Hemlock-Beech Association
B-B-M—Beech-Birch-Maple Association
RO-C-RM—Red Oak-Chestnut-Red Maple Association
MM-WP—Mixed Mesophytic Forest with White Pine
WP-Elm—White Pine-American Elm Association
O-H Sec.—Oak-Hickory Secondary Association

Certain indicator species should be picked out as soon as possible in the survey. For instance, chestnut and red oak in this region are indicators of Mixed Mesophytic Forest. Chestnut oak (*Quercus montana* Willd.), Black oak (*Quercus velutina*) and sassafras indicate oak-chestnut as the primary forest type. White pine occurs in acid bogs and in the Mixed Mesophytic Forest. The same is true of the cucumber tree in Cattaraugus county. Occasional individuals of these two species are also encountered in the Hemlock-Beech Association.

Important physiographic features such as cliffs, falls, glacial moraines and outwash can also be indicated, if not obviously shown on the topographic map. Important natural boundaries should be crossed several times. Observations should be made on both sides of mountains and hills, since important differences in vegetation are evident on different slopes, particularly south and southwest-facing slopes compared with north and northeast-facing slopes. The vegetation of ridge tops is frequently in striking contrast to the vegetation of valley bottoms and slopes.

STUDY OF EARLY LAND SURVEYS

Considerable use was made of the original land survey of 1799 for the Holland Land Company. The surveyor's notes made by Joseph Ellicott have been carefully copied and preserved, together

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CATTARAUGUS QUADRANGLE

Figure 10 Cattaraugus (N. Y.) quadrangle, showing locations and names of witness trees

with the original lot maps, with names and diameters of the witness trees at each corner. These maps were made available through the courtesy of Leo Krampf, deputy clerk of Cattaraugus county, Little Valley, N. Y. The lot maps were of greatest value, since most of the lots were rectangular and usually less than one mile square, frequently only three-quarters of a square mile in area. Since dimensions were given in chains and links, it was possible to transfer the lot maps to the topographic sheets, making suitable reduction in scale. The names or abbreviations of witness trees were written in at each lot corner, which was marked with a cross on the topographic map (figure 16). In this work the writer acknowledges help received from Gordon S. Crowl, then a scholarship student at the Allegany School of Natural History. It was scarcely expected that a perfect fit would be secured, but it was really remarkable what good correlations were found. One of the most remarkable cases was the occurrence of balsam fir as a witness tree on a lot corner which happened to fall directly in the center of a small swamp in lower Red House valley, the only place in the Allegany State Park where this species is known to occur. Hemlock was indicated much more frequently as a witness tree in the state park than in any other section of the county. Beech was most frequently given and sugar maple, though second, was not close in frequency as a witness tree.

John M. Holt, of Quaker Bridge, who has been most generous in giving of his broad experience, says that the beech was more frequently selected by the surveyors as a witness tree. This was probably because it was then of little value for lumber, could be easily marked, and because it was a conspicuous tree, readily distinguished at all seasons of the year. The conscious selection of beech by the surveyors for witness trees can not alter the fact, however, that beech was probably the most numerous forest tree in the county originally. It occurred in all forest types from the Mixed Mesophytic Forest to the Hemlock Consociation. Beech was absent or grew to only small size in the Oak-Chestnut Forest and in some of the swamp forests of the county.

A comparable area in Warren and McKean counties in northwestern Pennsylvania was studied by H. J. Lutz ('30*c*). On the authority of an old land surveyor he states that "Gum (*Nyssa*) trees made especially good witness corners because they had low economic value and were generally left undisturbed." Sugar maple, or simply "sugar" as the tree was often referred to, was another favorite. On the Samuel Dale survey of about 174,000 acres of

land in 1814 and 1815, Lutz found that the most widely distributed species were hemlock, beech, birch, sugar maple, maple, white pine, and chestnut, all having frequency values of more than 55 per cent. Ash was also rather high in frequency value, over 30 per cent. By frequency he meant the number of pages upon which each of the species was referred to, in 157 pages of notes.

"In order to get an expression of the numerical abundance of each species, the number of times each tree was referred to was tabulated. Although a total of thirty-two species were mentioned, relatively few of them made up the bulk of the stand. Beech, hemlock, maple, birch, white pine and chestnut comprised over 88 per cent of the stand." Beech had an abundance of 30 per cent, hemlock 26 per cent, maple (chiefly sugar maple) 13 per cent, birch 6 per cent, white pine 6 per cent, and chestnut 5½ per cent, according to Doctor Lutz's tables.

Notations made by the surveyors along section lines were found useful in the present study. A portion of the topographic map of the Cherry Creek quadrangle is presented as an illustration (figure 17). In addition to the names of the witness trees, notations from the journal of Joseph Ellicott have been added. This gives a more complete picture of the great Conewango swamp below South Dayton, on the line between Cattaraugus and Chautauqua counties, as it appeared to the surveyor, September 12, 1798. It is interesting to note that he distinguishes between a "miry swamp" over muck or peat and an ordinary swamp over soils relatively low in organic matter.

USE OF TOPOGRAPHIC MAPS AND SOIL SURVEYS

In addition to their value for determining certain natural boundaries, the topographic maps and soil maps are useful in other ways, especially for interpolations. On account of the fact that many areas are absolutely denuded of all original vegetation and are now used for pasture or farm crops, these interpolations are quite necessary, if one is to make a map. It is reasonable to assume that contiguous areas on similar sites were covered with essentially the same vegetation. By "site" is meant the altitude, slope, exposure, relative relief and soil type.

For example, if we find an area of primeval forest consisting of hemlock, beech, maple, and yellow birch on an area of Volusia silt loam at an altitude of 1600 feet in a valley with a northeast aspect, we can assume that the next valley had the same type of forest originally, if relative relief, aspect and soil type are the same.

Or, if we find a bottomland forest of the White Pine-American Elm type on poorly drained flats where the soils belong to the "Eel" or "Wayland" series, we would infer that wherever such soils occurred in the rest of the valley, the vegetation could reasonably be mapped the same way. Differences in relative relief, moisture-holding capacity, aspect, drainage and maturity seem to be the most important factors affecting the character of the natural vegetation locally. The first and third features are shown on the topographic maps; the second, fourth and fifth can be learned from the soils map and descriptions.

In preparing the map of the original forest of Cattaraugus county, only reconnaissance maps were available for use (Howe, '35; Marbut, '35). Consequently little use could be made of them in this study, since they were too generalized. Greater use was made of the topographic maps in the following manner. By the use of data from the original land surveys, the witness trees were plotted on a set of topographic maps by means of colored symbols. Light green symbols were used for beech-sugar maple, dark green symbols for hemlock and yellow birch, red symbols for red oak and black oak, brown for chestnut and cucumber tree, and so on, each species having a symbol. On the topographic maps covered with colored symbols, a crayon sketch map was prepared. Recourse to field maps and field observations aided in determining the boundaries of the major vegetation areas. The land forms and contours shown on the topographic sheets were also useful as a guide. All available information was brought together in producing the final map.

HISTORICAL ACCOUNTS OF THE ORIGINAL FOREST

The original land survey records offer the greatest wealth of detail concerning the kind and quality of timber in the early history of this region. The following description of a slope near the Indian Reservation is illustrative:

> Upland of the 2d quality
> Timber, oak, and chestnut
> 43 ch. Thick underbrush of the same to the top of said hill not too steep for cultivation to the descent of the same hill to the commencement of
>
> Upland of the 3d Quality
> Timber chestnut and white pine
> Thence descending said hill too steep and stony for cultivation to a white oak post marked No. 11 and 12, being a corner of said Township and also a corner of Allegany Reservation aforesaid. Thence running from
> 11 ch. the aforesaid white oak post SOUTH sixty eight degrees EAST and commencing with

Upland of the 2d Quality
28 ch. Timber chestnut and white pine.
58 lks. Thence descending the side of said hill facing southwesterly not too steep for cultivation to a post standing in the western boundary line of the aforesaid Tract of fifty four thousand acres granted as aforesaid. Thence running from the aforesaid post NORTH along the western boundary line of the aforesaid Tract of fifty four thousand acres.
485 chs. to the first mentioned ironwood post at the place of beginning.
Explored the 17th day of October, 1798.
Joseph Ellicott
Surveyor
for
Holland Land Co.

Surveyors' descriptions of timber included areas from 10 to 15c chains in extent, covering hill tops and valley slopes. An abbreviated report on Township 1, Range 8 (now Elko Township) follows:

1) Upland of 1st quality
Timber black and white oak, cucumber and maple
2) Upland of 1st quality
Timber oak, sugar maple and chestnut
3) Upland of the 1st quality
Timber sugar maple, beech and birch
4) Upland of the 1st quality
Timber sugar maple, basswood, beech, poplar, hemlock and white pine
5) Intervale of the 1st quality
Timber butternut and elm
6) Upland of the 1st quality
Timber white oak, black oak, hickory, chestnut and white pine
Explored the 15th day of October, 1798
by Joseph Ellicott.

So frequently is "black oak" mentioned in the records that it must include *Quercus borealis* Michx., the northern red oak. As a matter of fact, black oak is relatively uncommon in this region, except on burned-over areas in the Allegany Indian Reservation.

Apparently all of the timber noted on the survey line of Township 1, Range 7 (now Red House Township) was "2d or 3d Quality" except one tract 25 chains across described as "Upland of the 1st Quality. Timber sugar maple, beech, basswood, hickory, white ash and white pine," to 257 chains. This would bring the line to the summit of Three Sisters mountain in the Allegany State

Park. Ten chains from here to the northwest boundary of the township was a distance of 215 chains (2⅞ miles) making 482 chains (6 miles) in the entire line. The last portion was described as "Upland of the 2d Quality. Timber black and white oak, beech, chestnut, basswood, hickory, white ash, white pine, birch and sugar maple." Here the line ran over the divide west of Bay State creek and into the Cricks run drainage as shown on the Randolph quadrangle.

L. A. Kenoyer concluded from a study of the same land survey notes of Joseph Ellicott in 1798 that the distribution of plant associations (forest types) was then practically what it is today. "In

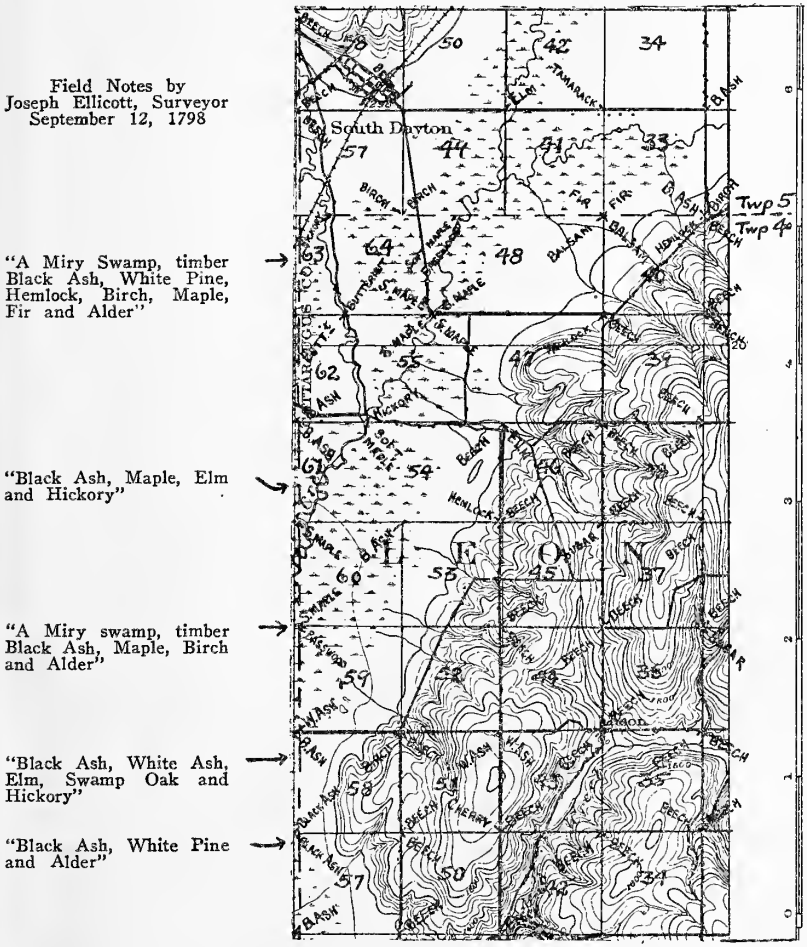

Figure 17 A portion of the Cherry creek (N.Y.) quadrangle, with surveyors' notes

the surveyors' books, windfalls with brakes, briars and underbrush are mentioned as occurring in a number of places. Other places are stated to have been burned over rather recently. Such places are generally near the reservation, and fires may perhaps be attributed to the Indians" (Kenoyer, '37).

Apparently the first pioneer white hunter familiar with this region who left a published account of his observations was Philip Tome ('54). On page 87 he describes the face of the country as he saw it on his hunting expedition more than six score years ago:

I will give a short description of the mountains and streams between Warren to Olean, on the east side of the river, where I once hunted elk, bears, panthers and sables. My first elk-hunting in this region was in 1816, and I continued it for five years. During this time I traveled over every section of Pennsylvania and New York, and became familiar with the country between the Allegany and the Susquehannah. In a circuit of ten miles around the head of the Tionesta, I thought the pine timber was better than in any other part of the region I have mentioned. The timber region commenced about seven miles from the Allegany river, two miles above Warren. The southeast branch heads in a good farming country, covered with beech, maples, chestnut, and some scattering wild-cherry trees, some of which latter measured three feet in diameter, and not a branch within fifty feet of the ground. Here were also white-wood trees, four feet in diameter, with the lower limbs sixty feet from the ground. The country round the mouth of the creek was covered with a magnificent growth of pine and oak. Hence to the head of Willow creek is a good farming country, covered with oak, chestnut, beech, maple and a sprinkling of pine, hemlock and wild cherry. Around the head of Tuneangwant creek and on the south side is also a good farming country. I never hunted on the north side, but have been told it is as good a country for farming purposes as the south side. From the Quaker run to the head of Tuneangwant, thence to Sugar run, Kinzua creek, and on to the Tionesta, I have been familiar and know it to be a good farming land.

White-wood is also interspersed through this region, of the finest quality, and growing to an immense size. Groves of small cherry trees, from six to fifteen inches in diameter, were quite numerous, and similar groves of white ash were often met with in places where the first growth had been prostrated by the wind.

That relative relief then exerted a controlling influence upon the composition of the forests is shown by the hunter's comments on page 106, regarding the habits of the white-tailed deer:

In June, they frequent beech and maple woods, or feed in the marshes bordering the streams. About the last of July they take to the highlands, among the chestnut and white oak woods, feeding on pea-vines and other herbage.

Two county histories have been published, largely on a subscription basis. This may account for the relative paucity of information concerning the natural vegetation of Cattaraugus county. The most informative article was written by Frederick Larkin on the "Great Lumber Industry" (Historical Gazetteer, William Adams, editor '93). In Chapter 11, he states:

Following the river to the north line of the state of Pennsylvania the valleys and hills on either side were rich with a splendid growth of pine. The Red House valley was about as remarkable for the great amount of pine timber as that of the Great valley. About 1840 some 14,000 acres of [the] land was purchased by a company in the city of Boston and has since been named the Bay State Tract. This tract was worked for a number of years and many millions of their pine timber was floated upon the Allegheny and Ohio rivers to the city of Cincinnati and various other towns and cities located on the Ohio. The first lumbering done in the Red House valley was adjacent to the river, as that afforded the only means to a permanent market, but since the advent of the railroads the vast amount of pine, hemlock, and hardwood remaining on the tract has readily found a market.

At the present time [1893] the hardwood [is] being shipped to Buffalo, Rochester, and Syracuse, and in fact to nearly all the eastern cities. Beech, maple, oak, chestnut, cucumber, ash and basswood are found in abundance.

In all of these historical accounts there appears a tendency of the authors to emphasize species of great economic importance. This was naturally to be expected. Several species are rarely mentioned in their accounts, and yet must have entered into the composition of certain primary forest types. American elm and hornbeam (both *Ostrya virginiana* and *Carpinus caroliniana*) are fairly common today in forests on moist sites. Sassafras, dogwood (*Cornus* sp.), striped maple or moosewood *(Acer pennsylvanicum),* mountain maple or elkwood *(Acer spicatum)* and large-toothed aspen *(Populus grandidentata*) frequently occur in the drier phases of the Mixed Mesophytic Forest and in the Oak-chestnut type. It is difficult to tell from historical accounts how abundant they were in the original forest.

INTERVIEWS WITH OLD SETTLERS

There are a number of persons now living in Cattaraugus county who can vividly remember the days of the great lumbering enterprises, especially the last quarter of the 19th century (1875–1900). They can recall the sites of former sawmills in the Allegany State Park and the great lumber rafts sent down the Allegheny river

from Olean and vicinity. It is naturally most difficult to find persons who recall the period from 1850 to 1875. Some of them were only children at the time, but may have heard from their parents about pioneer conditions.

The following persons have been helpful in supplying information about early forest conditions: John M. Holt, Quaker Bridge; Irving J. Nies and M. M. Moffat, Salamanca; John J. Walker and Frank Waters, Limestone; Howard Carr, Red House; W. J. Ryan, West Valley; and Mrs George Watson, East Dayton.

All of them agree that white pine and hemlock were scattered through several types of forest, that hemlock and beech occurred frequently in pure stands, and that yellow poplar (*Liriodendron tulipifera*) was comparatively rare in this section. For a botanist accustomed to the vegetation of the Ohio valley, the absence of black walnut (*Juglans nigra*), hackberry, (*Celtis occidentalis*), honey locust (*Gleditsia triacanthos*), bur oak (*Quercus macrocarpa*) and buckeye (*Aesculus* sp.) from the forests of this region is a striking feature. There is slight evidence that pitch pine (*Pinus rigida*) occurred originally in the southwestern part of Cattaraugus county (Knobloch, '35) but there are no historical records to support such a conclusion.

THE CLIMAX FOREST FORMATION

There is no question but that the prevailing vegetation of the county belongs to the "Eastern Hemlock-White Pine Hardwood" region as defined by G. E. Nichols ('35) or simply "Eastern Hemlock" region. Several other names have been applied to the same forest region or climatic plant formation, for example the following: Northern Pine belt (Sargent, '84), Northern Hardwood region (Frothingham, '15), northeastern "transition forest" region (Nichols, '18), the Allegheny Hardwoods, Pine and Hemlock region (Dana, '30), and the Lake Forest (Weaver and Clements, '29).

The writer is inclined to agree with Nichols ('23) and Lutz ('28) in their concepts of a climatic climax association, namely the most advanced type of vegetation that is capable of development under the climatic conditions which characterize a climatic region. In Cattaraugus county, New York, as in southern New England, the climatic climax forest is one of Eastern hemlock in pure stands or hemlock mixed with the northern hardwoods, beech, sugar maple and yellow birch. Synonyms for this type of forest include Hemlock-Hardwood Association (Lutz, '28), Hemlock Consociation (Lutz, '30*a*), and Hemlock-Beech Association (Hough, '36).

Figure 18 A climax forest of the Hemlock–Beech type in northern Pennsylvania

Figure 19 A secondary "oak forest" consisting of relatively young growth

Figure 20 A mixed mesophytic forest area at Roads'-end Ranch near Allegany

Figure 21 A secondary forest of sugar maple in Allegany State Park

A. F. Hough made a detailed analysis of a climax forest community on East Tionesta creek in northwestern Pennsylvania. There is no essential difference in composition between the climax forest there and in Cattaraugus county, New York. "The dominant stand (trees 70 feet and over in height) is made up almost entirely of hemlock and beech with small percentages of sugar maple, yellow birch, red maple, black birch, black cherry, and others. Compared with Heart's Content the absence of white pine is significant, and the East Tionesta forest represents a more advanced ecological stage believed to be the climatic climax of the region" (figure 18).

Of the shrubby and herbaceous vegetation in the Hemlock-Beech forest of this region, the commonest plants are:

Shining club moss	*Lycopodium lucidulum*
Common wood fern	*Dryopteris spinulosa* var. *intermedia*
True wood sorrel	*Oxalis acetosella*
Partridge-berry	*Mitchella repens*
Hobblebush	*Viburnum alnifolium*
False lily-of-the-valley	*Maianthemum canadense*
Foam flower	*Tiarella cordifolia*

Other ground cover species that occur in somewhat less abundance are:

Smaller enchanter's nightshade	*Circaea alpina*
Yellow clintonia	*Clintonia borealis*
Round-leaved yellow violet	*Viola rotundifolia*
Large-leaved white violet	*Viola incognita*
Indian cucumber root	*Medeola virginiana*
Starflower	*Trientalis americana*
False violet	*Dalibarda repens*

THE EDAPHIC CLIMAX ASSOCIATIONS

THE OAK-CHESTNUT FOREST

The Oak-Chestnut Association occupies the driest sites in the county, on ridges where there is considerable relative relief and on exposed south and southwest slopes, especially along the Allegheny river and its tributaries. It grades imperceptibly into the Mixed Mesophytic Forest and was not previously distinguished by botanical workers in this region until a few years ago, during a survey of the Allegany State Park. Other names that appear to be synonymous are Chestnut Oak-Black Oak Association (Jennings, '27), the Oak-Hickory forest (Taylor, '28), and the Oak Type (Dana, '30). The term "Oak type" is particularly applicable to the secondary forests that have resulted from logging, fires and the bark disease of chestnut caused by a fungus, *Endothia parasitica* (figure 19).

The dominants in the Oak-Chestnut Association are white oak (*Quercus alba*), red oak, chestnut, chestnut oak and black oak. Due to the death of chestnut trees in the region, a mixed oak type has developed. Codominants include white pine, red maple, pignut hickory (*Carya glabra* Sweet), black birch, large-toothed aspen, trembling aspen (*Populus tremuloides*), pin cherry (*Prunus pennsylvanica*), sour gum (*Nyssa sylvatica*), dogwood and sassafras. The undergrowth is a mixed heath, containing the following shrubs and half shrubs:

Low blueberry (Early)	*Vaccinium pennsylvanicum*
Low blueberry (Late)	*Vaccinium vacillans*
Black huckleberry	*Gaylussacia baccata*
Aromatic wintergreen	*Gaultheria procumbens*
Trailing arbutus	*Epigaea repens*
Pinxter flower	*Azalea nudiflora* L.
Deerberry	*Polycodium stamineum*
Arrow-wood	*Viburnum acerifolium*
Bush honeysuckle	*Diervilla Lonicera* Mill.
Mountain laurel	*Kalmia latifolia*
Sweet-fern	*Comptonia peregrina*

The ground cover of shrubs is supplemented by a layer of herbaceous vegetation, of which the following species are commonly observed:

Bracken	*Pteris aquilina*
Starry campion	*Silene stellata*
New Jersey tea	*Ceanothus americanus*
Black cohosh	*Cimicifuga racemosa*
Cow wheat	*Melampyrum lineare*
Pointed-leaved tick trefoil	*Meibomia grandiflora*
Dillen's tick trefoil	*Meibomia Dillenii*
Fringed milkwort	*Polygala paucifolia*
Seneca snakeroot	*Polygala Senega*
White clintonia	*Clintonia umbellulata*
Large-flowered bellwort	*Uvularia grandiflora*
Wild sarsaparilla	*Aralia nudicaulis*
Barren strawberry	*Waldsteinia fragarioides*
Upland blue violet	*Viola triloba*
Hairy panic grass	*Panicum huachucae*
Low white-haired grass	*Panicum linearifolium*

THE MIXED MESOPHYTIC FOREST

The Mixed Mesophytic Forest is an association made up of several important dominants, some of which occur in the Oak-Chestnut forest of drier sites and some of which belong to the Beech-Maple and Hemlock-Beech associations of moister sites. Various names have been applied by foresters and others to describe this kind of forest, which is widely distributed in eastern United States. Examples are the following: "Cove Hardwoods" (Frothingham and others, '26), "the hardwood association" (Lutz, '28), "mixed-

hardwoods type" (Dana, '30), and "beech-hemlock-oak-chestnut mictium" (Williams, '36). The first use of the term "mixed mesophytic" must be credited to E. Lucy Braun ('16), who recognized a forest association in the vicinity of Cincinnati, Ohio, which may have been a transitional community of another type, probably a phase of the Swamp Forest succession in which there are also a great number of important dominant species (Sampson, '30*a*). As the term is here used, the Mixed Mesophytic Forest is a forest occupying well-drained and well-aerated soils, always moist, and favorable to the dominance of a wide variety of tree species.

That there are a great many geographic variants or "segregates" of the Mixed Mesophytic Forest is appreciated by anyone who has made a critical study of them. Seven distinct segregates were recognizable in a study of the vegetation of Pine mountain in Eastern Kentucky (Braun, '35*b*). No virgin forests of the Mixed Mesophytic type are to be found today in Cattaraugus county. Observations on the least disturbed secondary forests must necessarily be used to describe the usual composition.

The dominants include the following trees: red oak, beech, chestnut, red maple, black birch, white ash, and black cherry (figure 20). Less frequent are cucumber tree, white oak, yellow poplar, white pine, basswood, bitternut hickory (*Carya cordiformis* Aschers and Graebn.), sugar maple, hop hornbeam and striped maple. Chestnut oak, black oak and large-toothed aspen are usually absent from the mixture, but become increasingly abundant on drier sites. Yellow birch, and blue beech are likewise absent, since they appear to require moister site conditions.

In the Mixed Mesophytic Forest shrubs make up an important part of the undergrowth vegetation. This is in striking contrast to their role in the Hemlock-Beech Association, where hobblebush is often the only species to be found in the undergrowth. The shrubs of the Mixed Mesophytic Forest include the following:

Arrow-wood	*Viburnum acerifolium*
Pinxter flower	*Azalea nudiflora* L.
Smooth service berry	*Amelanchier laevis*
Bush honeysuckle	*Diervilla Lonicera*
American fly honeysuckle	*Lonicera canadensis*
Witch hazel	*Hamamelis virginiana*
Round-leaved dogwood	*Cornus rugosa*
Alternate-leaved dogwood	*Cornus alternifolia*
Low blueberry	*Vaccinium vacillans*

The ground cover in the Mixed Mesophytic Forest is far richer in species than the vegetation of the Hemlock-Beech Association. The humus layer is relatively thin and decomposes rapidly due to

the activity of fungi on the surface and soil bacteria within the upper layers. These conditions, correlated with greater insolation and better internal drainage of the soil account for the presence of the following herbaceous plants:

Interrupted fern	*Osmunda Claytoniana*
Marginal shield fern	*Dryopteris marginalis*
Trailing ground-pine	*Lycopodium complanatum*
Ground-pine	*Lycopodium obscurum*
White clintonia	*Clintonia umbellulata*
Hairy disporum	*Disporum lanuginosum*
White baneberry	*Actaea alba*
Early meadow rue	*Thalictrum dioicum*
Black cohosh	*Cimicifuga racemosa*
Wild geranium	*Geranium maculatum*
Wild sarsaparilla	*Aralia nudicaulis*
Round-leaved pyrola	*Pyrola americana*
Fringed milkwort	*Polygala paucifolia*
Stoneroot	*Collinsonia canadensis*
Wild liquorice	*Galium circaezans*
Black snakeroot	*Sanicula marylandica*
Large-leaved aster	*Aster macrophyllus*
Flat-topped white aster	*Aster umbellatus* (Mill.)
Wreath goldenrod	*Solidago caesia*
Tall rattlesnake root	*Prenanthes trifoliolata* (Fernald)

In the drier phases of the Mixed Mesophytic Forest, the undergrowth is practically indistinguishable from that of the Oak-Chestnut Association. In the moister phases, the composition of the ground cover becomes similar to that of the Beech-Maple Association, which will next be described.

THE BEECH-SUGAR MAPLE FOREST

The Beech-Sugar Maple Association is characterized by the lack of hemlock and yellow birch, which are usually found on moister slopes. Most of the so-called Beech-Maple and Maple-Beech forest to be seen in the region today is secondary following the destruction of hemlock and white pine about 40 years ago (figure 21).

The original Beech-Sugar Maple Association was usually contiguous to the Hemlock-Beech Association, but occupied better drained soils nearer the ridge tops. It was apparently more extensive in the glaciated portion of the plateau, often occurring on soils of the Wooster series. In some cases the Beech-Sugar Maple type became established following windfalls in the Hemlock-Beech Association. The data from the earliest land survey are not adequate to distinguish areas covered with beech-sugar maple from areas of hemlock-beech. They can sometimes be distinguished in the field, however, by differences in ground cover and humus types. The deciduous type occurs more frequently on "crumb mull"

soils in which leaf litter decomposes rapidly, forming a shallow humus layer with little organic matter in the "A" horizon. The coniferous type occurs more often on "mor" soils in which a thick layer of "greasy duff" covers a podzol enriched with "raw humus" and products of its decomposition (Romell and Heiberg, '31; Romell, '35).

The species composition of the Beech-Sugar Maple Association involves the following dominants: beech, sugar maple, basswood, white ash, black cherry, and in this region, white pine. That it represents an edaphic climax or subclimax can scarcely be doubted, because the reproduction generally consists of the same species. This type of forest tends to perpetuate itself under existing environmental conditions. The undergrowth in the Beech-Sugar Maple is largely herbaceous and is rich in ferns and early spring flowers, including:

Christmas fern	*Polystichum acrostichoides*
Marginal shield fern	*Dryopteris marginalis*
New York fern	*Dryopteris noveboracensis*
Maiden-hair fern	*Adiantum pedatum*
Virginia grape fern	*Botrychium virginianum*
Sharp-lobed hepatica	*Hepatica acutiloba*
Spring-beauty	*Claytonia caroliniana*
Squirrel-corn	*Dicentra canadensis* (Walp.)
Wild ginger	*Asarum canadensis*
Canada violet	*Viola canadensis*
Hairy yellow violet	*Viola pubescens*
Blue cohosh	*Caulophyllum thalictroides*
White baneberry	*Actaea alba*
Large-flowered trillium	*Trillium grandiflorum*
Wild leek	*Allium tricoccum*
Jack-in-the-pulpit	*Arisaema triphyllum*

Grasses and sedges are obviously shade-tolerant forms:

Plantain-leaved sedge	*Carex plantaginea*
Spreading sedge	*Carex laxiculmis*
Graceful sedge	*Carex gracillima*
Bearded short-husk	*Brachyelytrum erectum*
Bottle-brush	*Hystrix patula* (Moench.)
Nodding fescue grass	*Festuca nutans* (Spreng.)
Nerved manna grass	*Glyceria nervata* (Willd.) Trin.

THE BOTTOMLAND HARDWOOD FORESTS

The Bottomland Hardwood Forests along the Allegheny river, Cattaraugus creek and their tributaries represent the "youngest" primary vegetation in the region. So variable are they that it is scarcely possible to distinguish definite plant associations. Cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), American elm, silver maple (*Acer saccharinum*) and black willow (*Salix nigra*) are species most often found on river banks and small

islands (figure 22). The flood plains contain considerable numbers of butternut trees (*Juglans cinerea*) and the original survey records make frequent mention of this species. Perhaps it would be desirable to speak of a Sycamore-American Elm-Butternut Association, following the pioneer Black Willow and Cottonwood Association. Box elder (*Acer negundo*), red maple and a number of shrubs and woody vines occur, forming a jungle-like mass of vegetation.

The woody plants include:

Elderberry	*Sambucus canadensis*
Arrow-wood	*Viburnum dentatum*
Wild black currant	*Ribes americanum*
Red osier dogwood	*Cornus stolonifera*
Summer grape	*Vitis aestivalis*
Poison ivy	*Rhus toxicodendron*
Virginia creeper	*Psedera quinquefolia*
Virgin's-bower	*Clematis virginiana*

Herbaceous vines are more plentiful than in any other habitat. Among these are:

Hog peanut	*Amphicarpa monoica* (Ell.)
Wild yam	*Dioscorea villosa*
Hedge bindweed	*Convolvulus sepium*
Bittersweet	*Solanum dulcamara*

Herbaceous undergrowth is decidedly tall and dense and is composed of species that require considerable moisture and a soil rich in the elements of fertility, nitrogen, potassium, phosphorus, magnesium and calcium. A long list of such plants could be included here, but only the more common species will be mentioned. The flowering herbs include those which bloom in midsummer, such as:

Canada lily	*Lilium canadense*
Larger blueflag	*Iris versicolor*
American white hellebore	*Veratrum viride*
Thimble-weed	*Anemone virginiana*
Fall meadow rue	*Thalictrum polygamum* Muhl.
Tall wild nettle	*Urtica procera* Muhl.
Wood nettle	*Laportea canadensis* Gaud.
Wild touch-me-not	*Impatiens biflora*
Wild parsnip	*Pastinaca sativa*
Cow parsnip	*Heracleum lanatum*
Fringed loosestrife	*Steironema ciliatum*
Purple boneset	*Eupatorium purpureum*
High goldenrod	*Solidago altissima*
Purple-stemmed aster	*Aster puniceus*
Green-headed coneflower	*Rudbeckia laciniata*
Ox-eye	*Heliopsis helianthoides*
Great ragweed	*Ambrosia trifida*
Swamp sunflower	*Helenium autumnale*
Wild lettuce	*Lactuca canadensis*

Among these are tall grasses and sedges and "weeds" with inconspicuous flowers. The grasses are:

Wild rye	*Elymus virginicus*
Tall wood chess	*Bromus altissimus* Pursh.
Rice cut grass	*Leersia oryzoides* Sw.
Deer-tongue grass	*Panicum clandestinum*

Common sedges:

Fox sedge	*Carex vulpinoidea*
Sallow sedge	*Carex lurida*
Blunt broom sedge	*Carex tribuloides*
Lake-bank sedge	*Carex lacustris*
Hop sedge	*Carex lupulina*

Among the pteridophytes growing in the flood plains of the larger streams are:

American ostrich fern	*Pteretis nodulosa*
Sensitive fern	*Onoclea sensibilis*
Northern lady fern	*Athyrium angustum* var. *elatius*

THE WHITE PINE-AMERICAN ELM FOREST

The White Pine-American Elm Association is the name given here to the type of forest that occupied much of the river "flats," in flood plains of the Great Conewango and Allegheny River valleys. In the primary forests existing today, the American elm is an uncommon species. It seems to be more frequent in the secondary forests. For this reason the position of American elm as an important species in the primary forests of the region has not been appreciated. To be sure, this species is more common on the river flood plains and islands than in any other physiographic habitat. It was not until the season of 1935 that investigations disclosed the nature of the edaphic climax in the great river valleys of this county.

According to information obtained from Albert Waites and his sister, Mrs George Watson, who live near East Dayton, white pine and American elm were dominants in the extensive swamp forests of Dayton township. Mr Waites's father bought a farm of 369 acres from the Holland Land Company about 70 years ago. The white pine had been logged off just previously. Henry Markham "drew" pine from the Waites's farm and operated a sawmill and shingle mill by water power at "Markham's," a hamlet on the highway between Gowanda and East Dayton. When Mrs Watson was a little girl, she often drove with her father across the swamp on the Fair Plains road, which was then timbered or "corduroy." It was just wide enough for the buggy, with turnouts

at various places. There was an almost solid stand of elms of large diameter along this road, and pine "stump land" was present all through the region. In addition to American elm, these forests contained "key ash" (meaning black ash), swamp oak (*Quercus bicolor*) and soft maple with scattered white pine, yellow birch and hemlock, "now and then a tree." Almost any hard rain would result in an overflow of the creek and water would stand for weeks at a time to a depth of about three feet. At the next farm below Waites's place, was a "hemlock knoll," according to Mrs Watson. Balsam and tamarack grew in "Dutch swamp," so-called from an old German settlement at "Fair Plains."

In a cut-over portion of the Conewango swamp on the "Fair Plains" road southwest of Wesley in Dayton township the following species occurred in 1935: White pine stumps, hemlock, yellow birch, American elm, black ash (*Fraxinus nigra*), white ash and red maple, with an undergrowth of elderberry, American yew and some winterberry (*Ilex verticillata*). Other weedy plants included spicebush (*Benzoin aestivale*) and poison ivy. The sensitive fern was also present in considerable abundance in the ground cover, along with yellow clintonia, wood nettle, goldthread (*Coptis trifolia*) and other species recorded for the little "Balsam swamp" in lower Red House Valley, within the Allegany State Park (House and Alexander, '27).

In a broad valley north of Otto, N. Y., there is much cut-over forest land of the same character. White pine stumps are frequent, American elms are numerous, along with some hemlock and yellow birch (figure 23). Less numerous are basswood and cucumber tree. Beech is found on knolls, where better drainage exists. The understory of small trees and shrubs includes hop hornbeam, blue beech, spicebush, winter berry and American yew.

THE BLACK SPRUCE-TAMARACK BOG FOREST

The Black Spruce-Tamarack Forest is of limited extent in Cattaraugus county, being confined to peat bogs of glacial lake origin in the northern half, particularly the northeastern section of the county. At Beaver Siding, in Ashford township, a remnant still exists on property belonging to W. J. Ryan, of West Valley. According to Mr Ryan, the muck and quicksand were so deep that 65-foot piling did not reach solid bottom when the railroad was built. Support of the roadbed was finally accomplished by using coke for ballast. The black spruces and tamaracks were here over-

Figure 22 A fringe of bottomland forest along Cattaraugus creek near Gowanda

Figure 23 White pines and American elms in a swamp forest near East Otto

Figure 24 "Botanizing" in the Cassandra heath at Waterman swamp

Figure 25 A *Carex–Calamagrostis* marsh at west end of pond at Farmersville Station

topped by white pine, which is one of the pioneer conifers in plant succession on bogs. These were surrounded by the usual mixed Bog Forest community with a considerable amount of red maple, black ash and balsam fir (*Abies balsamea*). Cucumber tree and mountain ash (*Sorbus americana*) were infrequent. There was not much elm. Undershrubs were mountain holly, withe-rod and sour-top blueberry. Almost the only herbaceous plant on the thick carpet of pine needles was false lily-of-the-valley. The black spruces which originally grew in this habitat reached eight or ten inches in diameter and were used in manufacture of ladders. The tamaracks were reputed to be of excellent quality and produced poles 65 feet long. These were used for staking fish nets in Lake Erie near Northeast, Pennsylvania.

THE CASSANDRA HEATH

A Cassandra Heath Association of leatherleaf and labrador tea occurs over an area of a few hundred acres at Waterman swamp (figure 24). Here it is associated with sour-top blueberry, black chokeberry and other bog shrubs. Stunted black spruces and tamaracks are scattered through this association, but have not attained dominance.

THE CALAMAGROSTIS MEADOW

A poorly drained grassland covered some of the peat deposits in the vicinity of Beaver Meadows, and there is good evidence that it occurred elsewhere in the northeastern townships, centering about Machias. At Farmersville Station there is a circular meadow of blue-joint grass (*Calamagrostis canadensis*) surrounding a zone of shrubs, which in turn surround a small lake (figure 25). Other perennials which form the meadow are:

Tall manna grass	*Panicularia* (Glyceria) *grandis*
Wool grass	*Scirpus cyperinus*
Inflated sedge	*Carex vesicaria*
Sickle sedge	*Carex crinita*
Narrow-leaved cat-tail	*Typha angustifolia*
Larger blueflag	*Iris versicolor*

In the shrub zone are:

Hoary alder	*Alnus incana*
Silky willow	*Salix sericea*
Shining willow	*Salix lucida*
Buttonbush	*Cephalanthus occidentalis*
Swamp loosestrife	*Decodon verticillatus*
Low pasture rose	*Rosa carolina*
Narrow-leaved meadow-sweet	*Spiraea alba*

The soil is water-soaked alkaline muck (pH 7.5), probably mixed with "marl", or impure calcium carbonate. Herbaceous species in this zone include:

Sensitive fern	*Onoclea sensibilis*
Royal fern	*Osmunda regalis* var. *spectabilis*
Skunk cabbage	*Symplocarpos foetidus* Nutt.
Marsh cinquefoil	*Comarum palustre*
Water hemlock	*Cicuta bulbifera*
Smaller bur marigold	*Bidens cernua*

ZONATION AND SUCCESSION IN A PEAT BOG

An extensive bog of nearly 400 acres, previously referred to, lies about three miles west of Little Valley and three miles south of New Albion. Farmers in the region call it "Owlenburg Bog," although that name is here applied to a small bog-bordered pond lying to the south. "Waterman Swamp" is the name given on the map of the Cattaraugus quadrangle to the larger bog area.

The zonation and early stages of succession can best be seen at the smaller bog. An open water zone about 50 yards across, contains the white water-lily (*Castalia odorata*) as the chief aquatic plant (figure 26). This is bordered by a sphagnum meadow which has been well covered with characteristic herbaceous plants and invading low bog shrubs. The latter include:

Leatherleaf	*Chamaedaphne calyculata*
Large cranberry	*Oxycoccus macrocarpa*
Bog rosemary	*Andromeda glaucophylla*
Labrador tea	*Ledum groenlandicum*
Sour-top blueberry	*Vaccinium canadense*
Swamp loosestrife	*Decodon verticillatus*
Blue honeysuckle	*Lonicera villosa* var. *tonsa* Muhl.

Herbaceous plants in the bog meadow consist of the following forms:

Carolina yellow-eyed grass	*Xyris caroliniana*
White-beaked rush	*Rynchospora alba*
Wool-grass	*Scirpus cyperinus*
Bog sedge	*Carex paupercula*
Virginia cotton grass	*Eriophorum virginicum*
Narrow-panicled rush	*Juncus acuminatus* Michx.
Marsh St John's-wort	*Triadenum virginicum*
Buckbean	*Menyanthes trifoliata*
Round-leaved sundew	*Drosera rotundifolia*
Pitcher plant	*Sarracenia purpurea*
Grass pink	*Calopogon pulchellus* R. Br.
Rose pogonia	*Pogonia ophioglossoides*

The invading tree zone in approximate order of invasion can be divided into two groups of species: black spruce, tamarack and red maple; white pine, yellow birch and hemlock. Among the

Figure 26 Water-lilies fringe the sphagnum meadow at "Owlenburg bog"

Figure 27 A bog-bordered pond ("Owlenburg bog") in town of Napoli

trees are tall bog shrubs: mountain holly, withe-rod, high-bush blueberry and black-fruited chokeberry. Black spruce and tamarack soon become overtopped by the mature bog forest of white pine, hemlock, yellow birch and red maple. Undergrowth in the bog forest include specimens of high-bush blueberry, 12–15 feet tall, great laurel, smooth service berry and mountain ash. The low evergreen, American yew, grows here as an undershrub. Balsam fir, black ash and cucumber tree are infrequent, but only the last named of the three species appears to withstand much shade.

Cinnamon ferns grow with maximum luxuriance in the bog forest on the wet fibrous peat. Other shade tolerant herbs of the forest floor include:

Royal fern	*Osmunda regalis* var. *spectabilis*
Common wood fern	*Dryopteris spinulosa*
Shining club moss	*Lycopodium lucidulum*
Yellow clintonia	*Clintonia borealis*
Painted trillium	*Trillium undulatum*
False lily-of-the-valley	*Maianthemum canadense*
Gold thread	*Coptis trifolia*
Large-leaved white violet	*Viola incognita*
Sessile-leaved twisted-stalk	*Streptopus roseus*
True wood sorrel	*Oxalis Acetosella*
Foam flower	*Tiarella cordifolia*
Partridge-berry	*Mitchella repens*

Creeping snowberry (*Chiogenes hispidula*) occurs chiefly in the shade of tall bog shrubs and conifers.

The zones of plant communities at "Owlenburg Bog" are somewhat telescoped, and the Cassandra heath is only slightly developed on the bog meadow (figure 27). In the central portion of Waterman swamp, however, the Cassandra heath association is most extensive. The invading trees and tall shrubs are scattered through the heath, and it was possible to make a transect from a pool of open water to the climax forest. The accompanying diagram (figure 28) shows the way in which the zones of vegetation are arranged, from which we may infer the order of primary succession on acid peat bogs in our area.

ZONATION AND SUCCESSION AROUND ALKALINE LAKES

Stillson's pond, at East Randolph, N. Y., has served for more than 50 years to supply water power to local mills, pond ice for storage, and some fishing for the neighborhood (figure 30). It is entirely artificial and appears to be richer in large forms of aquatic

life than any other pond in the southern part of the county. The water feeding the lake contains lime, and water cress (*Radicula nasturtium-aquaticum* R. Br.) grows abundantly in the inlets.

Floating and submerged plants in the open water zone include Nuttall's pondweed (*Potamogeton epihydrus*), small pondweed (*Potamogeton pusillus*), lesser waterweed (*Elodea occidentalis* St John), sweet-scented white water lily (planted), greater duckweed

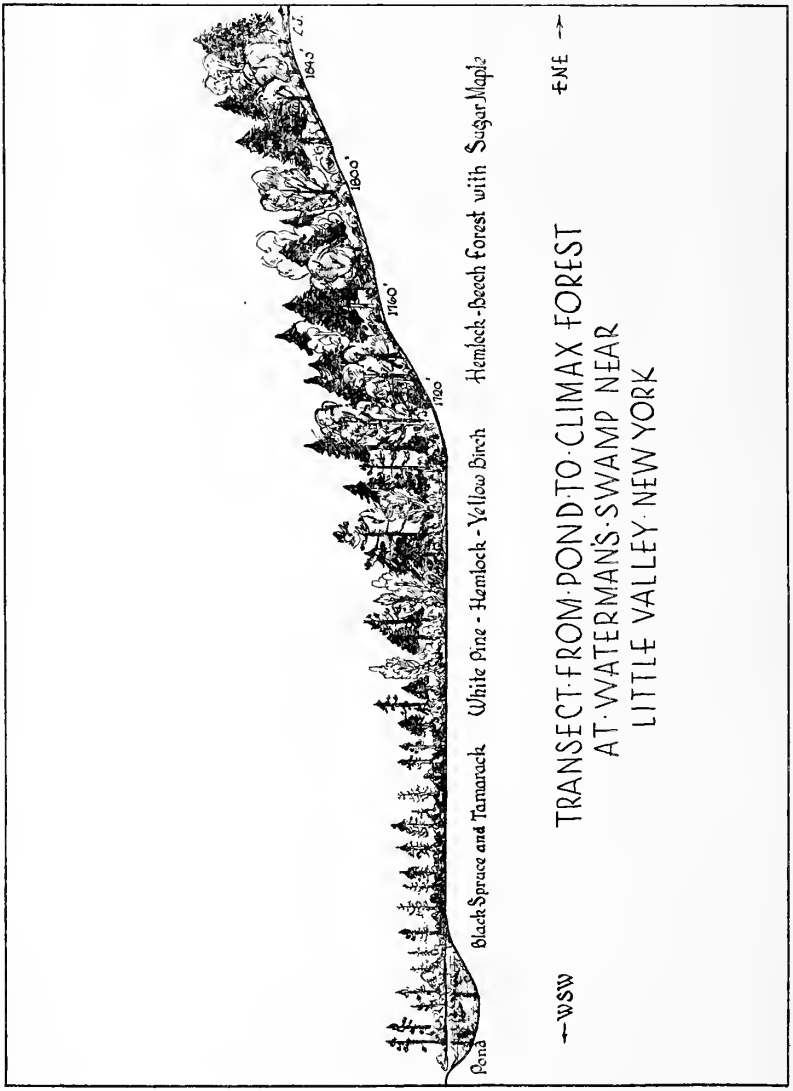

Figure 28 Diagram illustrating zonation of a bog. Drawing by Louis Jacobson from sketch supplied by Robert B. Gordon

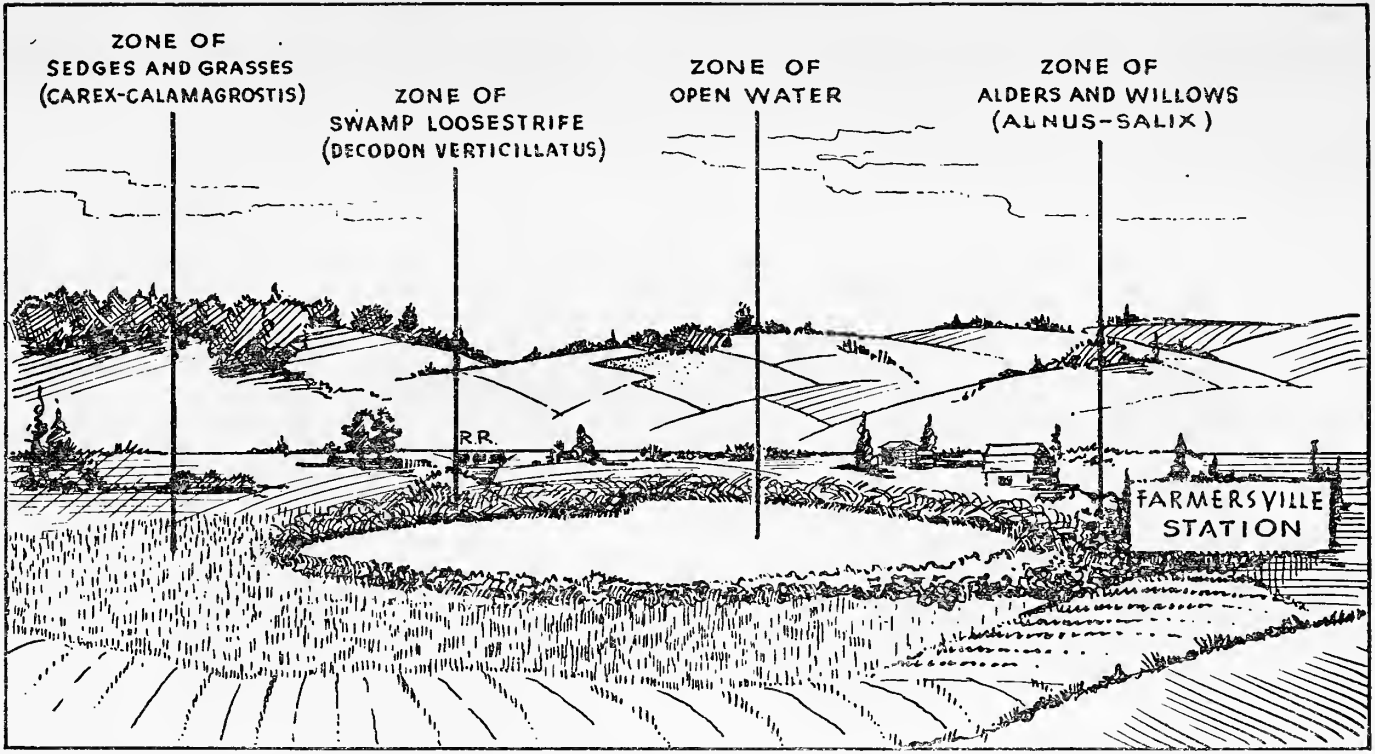

Figure 29 Zonation around an alkaline pond at Farmersville Station

(*Spirodela polyrhiza*) and lesser duckweed (*Lemna minor*). Growing in shallow water on the pond margins are colonies of common cat-tail (*Typha latifolia*), American great bulrush (*Scirpus validus*) and broad-leaved arrowhead (*Sagittaria latifolia*). The sedge zone in wet soil surrounding the pond at the east end is rich in species of swampy meadows. A list of such plants follows:

Wool grass	*Scirpus cyperinus*
Reddish bulrush	*Scirpus lineatus*
Leafy bulrush	*Scirpus polyphyllus*
Fox sedge	*Carex vulpinoidea*
Sickle sedge	*Carex crinita*
Blunt broom sedge	*Carex tribuloides*
Sallow sedge	*Carex lurida*
Blunt spike rush	*Eleocharis obtusa*
Tall manna grass	*Panicularia grandis*
Rice cut grass	*Leersia oryzoides*
Peppermint	*Mentha piperita*
Cut-leaved water hoarhound	*Lycopus americanus*
Common rush	*Juncus effusus*
Jointed rush	*Juncus articulatus*
Sweet flag	*Acorus Calamus*
Larger blueflag	*Iris versicolor*
Marsh St John's-wort	*Triadenum virginicum*
Clayton's bedstraw	*Galium Claytoni*
Lesser stitchwort	*Stellaria graminea*
Turtlehead	*Chelone glabra*
Swamp milkweed	*Asclepias incarnata*
Square-stemmed monkey flower	*Mimulus ringens*
Purple-stemmed aster	*Aster puniceus*
Late goldenrod	*Solidago serotina*
Boneset	*Eupatorium perfoliatum*

The shrub zone at the west end of the pond is largely a willow thicket, in which the most abundant species is the silky willow. Pussy willow (*Salix discolor*) and shining willow are relatively common, but heart-leaved willow (*Salix cordata*) is rather scarce. One specimen of bog willow (*Salix pedicellaris*) has been found here. Other shrubs include swamp rose, toothed viburnum (*Viburnum dentatum*), wild black currant (*Ribes americanum*) and elderberry.

In the shade of the shrubs, growing in water-logged muck, may be found:

Woodbine	*Clematis virginiana*
Wild touch-me-not	*Impatiens biflora*
Marsh shield fern	*Aspidium thelypteris* Sw.
Sensitive fern	*Onoclea sensibilis*
Cinnamon fern	*Osmunda cinnamomea*
Wood horsetail	*Equisetum silvaticum*

Several marly ponds occur in the northeastern townships. A few of them have been investigated in the course of this study. The pond at Farmersville Station is bordered by tall shrubs, surrounded by a wet grassy meadow (figure 29). The wet soil in

Figure 30 Stillson's pond, at East Randolph, with vegetation zones about 60 years old

Figure 31 Vegetation on conglomerate rocks is retarded in development at Olean Rock City

Figure 32 The Gowanda shales at Point Peter

the shrub zone is alkaline (pH 7.5) as determined by the colorimetric method with Hellige Soil Tester. Swamp loosestrife grows out into the lake by means of arching shoots which take root in the water and mud. Associated with this species in the shrub zone are silky willow, buttonbush, hoary alder, shining willow, swamp rose and meadowsweet.

Beaver lake in Freedom township is another marly pond bordered by a shrub zone of hoary alder, shining willow, pussy willow and meadowsweet. Submerged vegetation includes eel grass (*Vallisneria spiralis*) and pondweeds (*Potamogeton* sp. and *Elodea*). Unpastured portions have a natural meadow of Calamagrostis surrounding the tall shrub zone, but alders have spread where the meadows were pastured. The same observation was made in the "Beaver Meadows" north of Ashford.

ZONATION AND SUCCESSION ON CONGLOMERATE ROCKS

Within Cattaraugus county are several "rock cities," so-called from blocks of conglomerate which outcrop on the unglaciated plateaus. Most famous of these is the Rock City south of Olean, N. Y. Another is the Salamanca Rock City, and the third is within Allegany State Park, recently christened "Thunder Rocks." The geology of these areas has been explained in a popular way in a handbook of the New York State Museum (Lobeck, '27). The vegetation of the rock cities has also been previously described by House and Alexander ('27). There has been no attempt, however, to distinguish the various plant communities or to point out the dynamics of plant succession in such habitats.

At Olean Rock City the large blocks of conglomerate face generally westward, although several have been dislodged and separated from the main body, so that they face the four points of the compass. The rock faces are covered with lichens, among which are large forms of the rock tripe (*Gyrophora vellea* (L.) Ach. and *Umbilicaria pustulata* (L.) Hoffm.). Mosses (*Leucobryum glaucum* (L.) Schimp. and *Dicranum scoparium* (L.) Hedw.) with the reindeer lichen (*Cladonia rangiferina* (L.) Web.) form mats of low vegetation which succeed in holding moisture for longer periods than the rock material alone. This may be a factor in making it possible for seeds of certain shrubs and trees to germinate and for the seedlings to survive short periods of drouth.

The action of the moss and lichen carpet is aided by the ordinary agencies of weathering, which result in the loosening of sand particles from the conglomerate and the accumulation of talus below

them. In such habitats the seed of blueberry, black birch, red maple, white pine and mountain ash may germinate. The limit of succession on the conglomerate blocks is reached when a blueberry heath develops, composed mainly of *Vaccinium pennsylvanicum* var. *myrtilloides* and *Vaccinium vacillans*. Occasionally a red maple or a white pine or a mountain ash succeeds in growing into a stunted tree (figure 31).

Where leaf litter has had a chance to accumulate over the sandy soils derived from the conglomerate, an open forest of white pine, red oak, red maple, sweet birch and chestnut may develop. Shrubs in the forest include mountain laurel (*Kalmia latifolia*), black chokeberry and pinxter-flower. Many of the laurel bushes are eight feet tall, with stems averaging an inch and a half in diameter. Associated species are sassafras, sweet birch, mountain ash and mountain holly (*Ilex monticola*). Typical ground cover vegetation in the chestnut coppice at Olean Rock City includes: aromatic wintergreen, false lily-of-the-valley, Indian turnip, painted trillium and mountain aster (*Aster acuminatus* Nees).

On a ridge north of Olean, between Bennett hollow and Woodchuck hollow, a Beech-Maple-Hemlock Forest covers the north-facing slope to the top of the ridge. At the top, south and south-east-facing slopes, is a phase of the Mixed Mesophytic Forest, consisting of red oak, chestnut, red maple, white pine, sweet birch and hemlock. It seems to be an edaphic climax on ridges in this vicinity, occasionally varied by the presence of beech and cucumber trees of small diameter.

A decidedly mesophytic undergrowth occurs in the shrub stratum: pinxter-flower, hobblebush, striped maple, mountain holly and witch hazel. The herbaceous layer in these rocky habitats includes several ferns:

Common polypody	*Polypodium virginianum*
Hay-scented fern	*Dennstaedtia punctilobula*
Common wood fern	*Dryopteris spinulosa* var. *intermedia*
Marginal shield fern	*Dryopteris marginalis*
New York shield fern	*Dryopteris novaboracensis*

Other species are:

Yellow clintonia	*Clintonia borealis*
False lily-of-the-valley	*Maianthemum canadense*
Indian cucumber root	*Medeola virginiana*
Painted trillium	*Trillium undulatum*
Sessile-leaved twisted stalk	*Streptopus roseus*
Starflower	*Trientalis americana* (Pursh)
Wild sarsaparilla	*Aralia nudicaulis*
Beechdrops	*Epifagus virginiana* (Bart.)
Partridge-berry	*Mitchella repens*
Ground-pine	*Lycopodium obscurum*
Running-pine	*Lycopodium clavatum*

ZONATION AND SUCCESSION ON ERODING SHALES

The South Branch of Cattaraugus creek empties into the main stream east of Gowanda not far from Forty Bridge. In the lower part of its course it has cut a spectacular gorge separating two political subdivisions, Persia township to the west and Otto township to the east. The rock formations here are soft, easily eroded, and are known to local geologists as the Gowanda Shales.

At the mouth of Point Peter brook near Gowanda is a very steep and narrow ridge of shale separating the brook from the master stream, Cattaraugus creek. This ridge is undoubtedly the most exposed and driest habitat to be found in the region of the Gowanda Shales (figures 32 and 33). It is the only station known in the county for the Canadian Buffalo-berry (*Shepherdia canadensis* Nutt.). Associated with this unusual shrub is the glaucescent honeysuckle (*Lonicera glaucescens*), shadbush, white pine, white oak, trembling aspen, large-toothed aspen, witch hazel and hoary alder. The finding of hoary alder in this relatively xeric situation seems remarkable. It is usually found as a swamp shrub throughout the county.

A phase of the Mixed Mesophytic Forest occurs on the rim of the gorge of Cattaraugus creek at Gowanda. The following trees enter into its composition: white pine, red maple, white oak, red oak, chestnut, yellow poplar, basswood, black cherry and white ash. In the gorge itself is the usual mixture of hemlock and hardwoods, including yellow birch, beech, sugar maple, red maple and mountain maple. On a moist, dripping shale cliff in the gorge of Point Peter brook was found a remarkably vigorous colony of the bulb-bearing bladder fern (*Cystopteris bulbifera* Bernh.). It appeared to be reproducing entirely by the tiny buds or "gemmae" formed among the terminal leaflets. Relatively few of our ferns reproduce in this peculiar manner. Several specimens of a rather inconspicuous orchid, bastard hellebore *(Serapias helleborine),* naturalized from Europe, grew beside a foot path in the same locality.

At Forty Bridge, on the South Branch of Cattaraugus creek, the gorge is relatively wide (figure 34). A deciduous forest has developed on the coarse gravelly soil of the "first bottom." It consists of sycamore, white ash, American elm, red elm (*Ulmus fulva*), blue beech, butternut, basswood, red oak, sugar maple and black maple (*Acer nigrum* Michx.).

About six miles farther south in the same gorge the forest appears to be in a primeval condition. The west slope, in Persia

township, belongs to the Strickland estate. Both slopes and the older terraces are forested with hemlock, beech and yellow birch, with some sugar maple and American elm (figure 35). In the undergrowth are large clumps of American yew, alternate-leaved dogwood, hobblebush and running strawberry-bush (*Euonymus obovatus*). Herbaceous growth in this heavily shaded situation is sparse and consists largely of ferns, common wood fern, marginal shield fern, Christmas fern, shining club moss and false lily-of-the-valley. This vegetation undoubtedly represents the climatic climax of the region.

Eroding shales and siltstones furnish natural habitats for pioneer plants (figure 36). The species involved depend upon accidents of dissemination, whether the shales are wet or dry most of the time, and whether they are exposed to sunlight or deep shade. It is easiest to observe the early stages of succession on shales and siltstones where trails, road-cuts and railroad embankments are built. The common plants along the newer roads in the Allegany State Park best illustrate the pioneer stage of succession:

Common horsetail	*Equisetum arvense*
Firegrass	*Agrostis hyemalis*
Timothy	*Phleum pratense*
Fireweed	*Chamaenerion angustifolium* (Adans.)
Heal-all	*Prunella vulgaris*
Speedwell	*Veronica officinalis*
Spotted St John's-wort	*Hypericum perforatum*
Evening primrose	*Oenothera biennis*
Spreading dogbane	*Apocynum androsaemifolium*
White snakeroot	*Eupatorium urticaefolium*
Early goldenrod	*Solidago juncea*
Wrinkled-leaved goldenrod	*Solidago rugosa*
Zigzag goldenrod	*Solidago flexicaulis*
White woodland aster	*Aster divaricatus*
Large-leaved aster	*Aster macrophyllus*
Crooked-stemmed aster	*Aster prenanthoides*
Daisy fleabane	*Erigeron ramosus*
Pearly everlasting	*Anaphalis margaritacea*
Clammy cudweed	*Gnaphalium decurrens*
Fireweed	*Erechtites hieracifolia*
Gall-of-the-earth	*Prenanthes trifoliolata*
Rough hawkweed	*Hieracium scabrum*
Orange hawkweed	*Hieracium aurantiacum*

Where wet shales are exposed to shade conditions, a number of mosses and liverworts appear, followed very early by such species of herbs as the following:

Smaller enchanter's nightshade	*Circaea alpina*
Spotted jewel-weed	*Impatiens biflora*
Golden saxifrage	*Chrysosplenium americanum*
Sweet-scented bedstraw	*Galium triflorum*
Common wood fern	*Dryopteris spinulosa* var. *intermedia*
Long manna grass	*Glyceria melicaria*
Manna grass	*Glyceria nervata*

Figure 33 Point Peter, near Gowanda

Figure 34 Deciduous forest on bottomland at Forty Bridge

Figure 35 Steep slopes become forest-clad in the South Branch of Cattaraugus creek

Figure 36 Eroding shales furnish natural habitats for pioneer plants at Connoisarauley Falls

Invariably a shrub stage is reached, involving the following species:

Blackberry	*Rubus allegheniensis*
Red raspberry	*Rubus strigosus*
Flowering raspberry	*Rubus odoratus*
Choke cherry	*Prunus nana* (DuRoi, Harbk., Baumz.)
Red-berried elder	*Sambucus racemosa*
Common elderberry	*Sambucus canadensis*
Alternate-leaved dogwood	*Cornus alternifolia*
Staghorn sumac	*Rhus typhina*

The first forest trees to invade the thickets are pin cherry, red maple, white ash, wild black cherry and sugar maple, all of high reproductive capacity in this region. In the mixed Mesophytic Forest chestnut, white pine, red oak, and pignut hickory are important species in the final stages of plant succession.

A BRIEF HISTORY OF THE LAND FLORA

The present vegetation cover of Cattaraugus county may be better understood if the story of its development is pieced together beginning with the earliest known fossil plant remains in the Paleozoic strata which form the bed rock in this area. Estimates differ widely, but one of the latest and most authoritative gives their age approximately as 350 million years (Barrell, '17). The strata belong to the Upper Devonian and Lower Mississippian series. Most of the fossil-bearing rocks of Devonian age appear to be of marine origin. The sediments of which they are composed were laid down in shallow seas, estuaries and lagoons. Some of the coarse sandstones show considerable cross-bedding, which indicates that they were originally delta deposits or bars developed off-shore under the influence of strong oceanic currents. Changes in the shore line must have taken place very slowly.

The contact separating the Devonian from the Mississippian formations has long been a source of dispute among geologists Usually such questions are settled by reference to the fossils that are characteristic of the different formations (Goldring, '31). In the absence of fossils and in places where certain forms have persisted from one period to the next, it is really a difficult problem to decide. Plant fossils are usually dated with reference to the animal fossils found in the same or adjacent horizons. Rarely are plant fossils accepted as final evidence of the age of a given formation.

The Paleozoic strata exposed in Cattaraugus county, according to the most recent studies by G. H. Chadwick and others, include the following members:

Series	*Group*	*Thickness in feet*
Pennsylvanian:?	Pottsville:?	
Olean conglomerate		70
		unconformity.
Mississippian:		
Knapp shales and sandstones		100
Devonian:	Bradfordian:	
Oswayo shales and sands		270
Cattaraugus beds		370
	Chautauquan:	
Chadakoin ("Chemung") beds		550
Volusia (Girard) beds		180
Cuba sandstone		20
Machias and Rushford beds		400
Caneadea (Gowanda) beds		350

FLORA OF THE PALEOZOIC ERA

Just below the Knapp sandstone at the head of Quaker run, in the Allegany State Park, may be found a thin seam of coal from ancient plants. The Oswayo shales and sandstones frequently disclose impressions of wood several inches in length. All such fossils, however, are imperfectly preserved and indicate that the wood had been watersoaked and thoroughly decayed before burial in sediments of a shallow embayment. They are, nevertheless, the most ancient tree fossils thus far discovered in western New York. It is problematical what kinds of trees are represented. The better known in general are the following:

Tree ferns	*Archaeopteris obtusa*
	Archaeopteris jacksoni
Seed ferns	*Eospermatopteris textilis*
Calamites	Species of *Calamites*
Giant lycopods	*Protolepidodendron primaevum*
Primitive conifers?	*Callixylon oweni*

None of these plants is in existence today, and all we know about them has been deduced from fossil remnants found in New York, Pennsylvania, Ohio, Indiana and Michigan.

Some time during the Mississippian period, western New York was elevated and became part of a coastal plain extending as far south as Alabama. Rivers flowed westward across the old plain carrying sand and pebbles that piled up in deltas and off-shore deposits of considerable thickness. Upon hardening they formed conglomerates such as the Olean Conglomerate at Rock City. The source of the abundant quartz pebbles is yet unexplained. It has

been suggested that they were brought down by rivers from a former mountain region that existed where the Atlantic ocean now covers the continental shelf.

There are no fossil-bearing rocks in Cattaraugus county of more recent age than early Mississippian. This may mean that there was no sedimentation in western New York during the last periods of the Paleozoic era. During that long interval of time all of New York State was elevated and remained above the ocean, making marine sedimentation impossible. Another interpretation involves frequent submergences and emergences of the ancient coastal plain, during which some sedimentation could have taken place. These were subsequently eroded away completely during the thousands of centuries that have followed.

The late Paleozoic was characterized by an abundance of plant life, better known perhaps than any other fossil floras. This is chiefly because of well-preserved plant remains in various parts of the earth. Such fossils are located in rich bituminous coal fields that resulted from the incomplete decay of swamp vegetation that flourished in the Pennsylvanian period. Seed ferns, tree ferns, lycopods and calamites made up the bulk of the vegetation, and primitive conifers were evolving during the late Paleozoic.

At the close of the Permian period (end of the Paleozoic era) the entire Appalachian region was elevated two or three thousand feet above the sea. What was once a coastal plain became an elevated plateau west of the folded Appalachians.

GEOLOGICAL TIME TABLE

	Barrell's estimates
CENOZOIC ERA	
Pleistocene period	1 to 1.5 million years ago
Pliocene period	7 to 9 million years ago
Miocene period	19 to 23 million years ago
Oligocene period	35 to 39 million years ago
Eocene period	55 to 65 million years ago
MESOZOIC ERA	
Cretaceous period	95 to 115 million years ago
Comanchien period	120 to 150 million years ago
Jurassic period	155 to 195 million years ago
Triassic period	190 to 240 million years ago
PALEOZOIC ERA	
Permian period	215 to 280 million years ago
Pennsylvanian period	250 to 330 million years ago
Mississippian period	300 to 370 million years ago
Devonian period	350 to 420 million years ago

Adapted from Joseph Barrell (Geol. Soc. Amer. Bul., 28: 884–85, 1917)

FLORA OF THE MESOZOIC ERA

No fossils occur in Cattaraugus county, or for that matter, in all of western New York, to tell of the plant life since the Paleozoic, a period of nearly 200 million years, according to our time table. Why not? This question may best be answered by pointing out that there is little chance for preservation of plant remains except where sediments are forming. Most fossils occur where plants have been covered by sterile silts, carbonates, silicates, resins and volcanic ash. Under ordinary conditions all plant remains must eventually decay. Bacteria and fungi (nongreen plants) accomplish these results. The plant tissues may be converted into humus or may be transformed into invisible gases and vapors, in which case nothing remains of the original plant structures. When we consider also the feeding activities of insects and herbivorous animals, it is truly surprising that any fossils have remained to indicate the character of the ancient plant world.

The Appalachian region was probably one of the great theaters of evolution of the flowering plants. These made their appearance toward the close of the Lower Cretaceous, as shown by fossils found in the Potomac group of formations, where they are associated with descendants of Jurassic ferns, cycads and conifers. The flowering plants increased greatly in number during the upper Cretaceous, "which time marks the first modernization of the floras of the world, but they are accompanied until the close of the Cretaceous by the dwindling representatives of the older Mesozoic floras" (Berry, '37, p. 33).

Missing links are yet to be discovered, if indeed they exist, to connect the plant life of the Cretaceous with that of the Jurassic and Triassic. Particularly can this be said of the angiosperms (flowering plants with closed carpels which ripen into fruits with seeds). Many prominent families appear "full blown" in Cretaceous formations and are unknown in earlier or younger formations. Among these are the poplars and willows, oaks, magnolias, figs, aralias, sassafras and persimmons. Many of the fossil forms bear striking resemblance to modern species, in spite of the fact that more than 100 million years have elapsed since the Potomac beds were deposited.

A rather complete record of fossil plants from the Lower Cretaceous (Comanchean) to the present is preserved in the Atlantic Coastal plain of North America. This represents a time period variously estimated as between 120 and 149 millions of years. In the era following the Cretaceous, a rich coastal flora grew in the

southeastern states. A satisfying review of the Tertiary floras of eastern North America has recently been published by Berry ('37), who is acknowledged as a leading authority on this subject. Suffice it to say here that the close of the Tertiary period witnessed the complete development of a flora comparable to that now existing in the same region. We may conclude therefore that the present flora of unglaciated North America is one which is very old, having been in existence at least a million years, with certain forms persisting with slight variations for fifty million years or more.

WESTERN NEW YORK A MILLION YEARS AGO

The reader is now prepared for the statement that little change has occurred in the flora of the unglaciated area of western New York for the whole period of the Pleistocene, estimated by Barrell ('17) and Kay ('31) at nearly a million years and certainly no less than 700,000 years. Barrell based his estimate largely upon behavior of radio-active substances. Kay's estimates are based on studies of glacial and interglacial phenomena in Iowa.

There is little question that the relative relief exhibited in the southern part of Cattaraugus county is the result of an erosion cycle begun in the Tertiary period when the entire State of New York was uplifted 2000 to 3000 feet by a gentle warping of the earth's crust. The preglacial drainage of the county was entirely toward the north from the old Upland Erosion Surface (Cole, '37) into an extensive trough now occupied by the Great Lakes (figure 37).

The streams flowing off the higher portion of the plateau carried debris contributed by sheet wash and gradually changed soil moisture conditions by the development of valleys and ridges. Certain habitats became drier, and those species that could withstand periodic fluctuation of the water table survived occasional desiccation of the soil on the ridges. Lower slopes became moister and the river bottoms generally became more fertile. These changes affected competition among the various plants that occupied the terrain. At the same time microclimatic conditions were altered and the forest became differentiated into distinct associations such as we recognize today. Braun ('35) has hypothecated an undifferentiated forest climax during the Tertiary period, basing her claims on the widespread distribution of fossil species from the Cretaceous to the Pliocene and the present distribution of grassland, oak-hickory, beech-maple and oak-chestnut forests in the eastern United States. Changes in physiography and climate during the Pliocene and

Pleistocene epochs have changed the undifferentiated forest into a series of "association-segregates." It is an attractive point of view that deserves more serious attention from botanists interested in vegetational history. Certainly there must have been undifferentiated mixed mesophytic forests in western New York a million years ago.

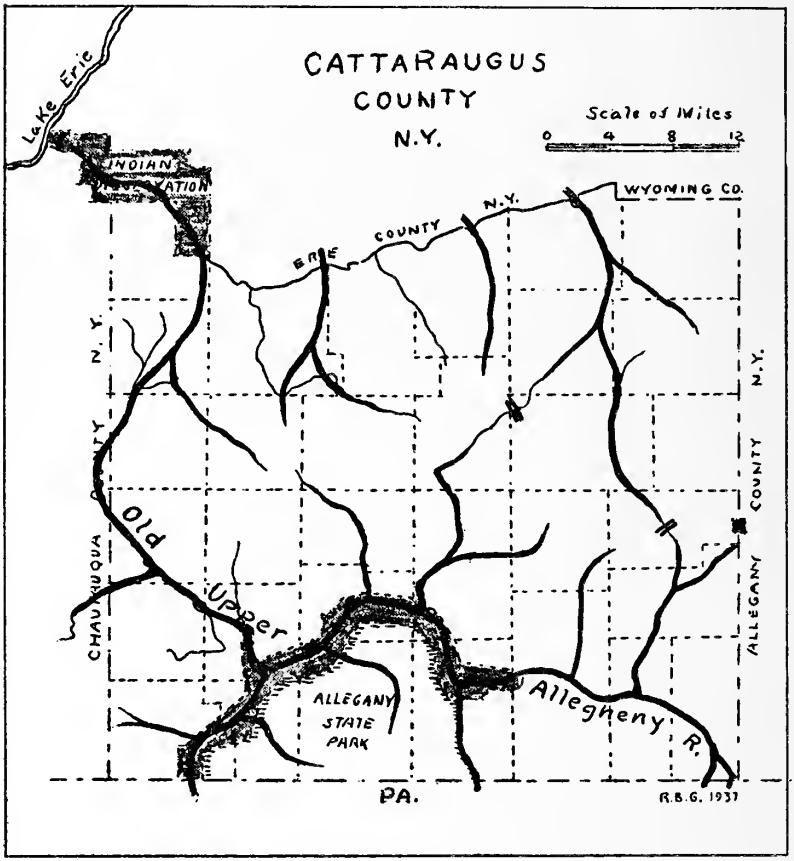

Figure 37 Map showing preglacial drainage in Cattaraugus county. Wide black lines indicate former channels. Adapted from Chamberlin and Leverett (1894).

THE EARLIEST GLACIATION

Since the investigations of Leverett were published in 1902 (U. S. G. S. Monograph 41) it has been supposed that western New York was the scene of two major glaciations, the earliest of which (Kansan or pre-Kansan) altered the northward-flowing stream pattern, diverting and in some cases reversing the flow. The course

of the present Allegheny river is a good example. It enters Cattaraugus county in the southeast corner from the south, flows northward and northwestward, then westward, and then bends southwestward and southward into Pennsylvania. It has not always followed the same course, however. At one time the Old Upper Allegheny river flowed northward from the vicinity of Steamburg through what is now the broad valley of Conewango creek (figure 37).

The accumulation of ice in a continental glacier that covered thousands of square miles and that was a mile to two miles in thickness at the center of accumulation is supposed to have withdrawn quantities of water from the atmosphere with a consequent reduction of sea level. With the first advance of Pleistocene ice, fluctuations in sea level and reversals of drainage brought about corresponding fluctuations in the erosion process, increasing it when the sea level was lowered and during the establishment of reversed stream courses.

In the vicinity of the Allegheny river at the present time the hills rise to an altitude of 2300 feet or more, while the bottomlands are about 1400 feet above sea level. The relative relief is therefore between 900 and 1000 feet. The river itself flows in a valley filled with outwash to a depth of 300 feet or more. The relative relief *above the rock floor* of the valley is considerably more than a thousand feet. It has been suggested that most of the deep cutting of the valley occurred during an interglacial epoch (Chamberlin & Leverett, '94). The deepening occurred mainly because of reversal of drainage with the resultant changes in gradients of tributary streams, particularly when their route was shortened by several miles. The same interglacial deepening may have been the result of uplift, following the melting of the continental ice mass, but Malott ('20) has accounted for much of the "deep stage" by "static rejuvenation."

The effects of glaciation on vegetation are largely destructive. So slow, however, did the ice accumulate and spread over the land that it was possible for many plants of the tundra and boreal evergreen forest to migrate with the ice. Not only the plants, but animals, too, are known to have come south with the glacial advances. Bones of the musk ox (*Ovibos moschatos*) discovered as far south as Pennsylvania, Kentucky and Arkansas lend support to this statement (Scott '13).

Few definite traces of the earliest glaciation can be found in Cattaraugus county. Old weathered drift deposits farther south in Pennsylvania have been studied by Leverett ('02, '34). He has pronounced them as Jerseyan in age, which means that they were definitely pre-Illinoian, but whether they were formed in the Kansan or Nebraskan glacial epochs is still undetermined.

THE LONG INTERGLACIAL EPOCHS

One of the oft-forgotten features of the Quaternary or Pleistocene period is the length of the interglacial epochs. The picture of an ice-covered landscape over areas now covered with snow only in the winter months is more spectacular than what is now commonplace.

The interglacial picture is difficult to reconstruct, but it is believed to have been much like the present. After many years of detailed study of the glacial features in Iowa, the State Geologist has prepared a relative time scale showing the probable length of each interglacial epoch compared with the epochs of glaciation (Kay, '31). Like all other geological time tables, this one should be read up, beginning with the earliest at the bottom of the list.

Post-late Wisconsin time	25,000 years
Wisconsin glacial time	3000 years
Peorian interglacial time	27,000 years
Iowan glacial time	3000 years
Sangamon interglacial time	120,000 years
Illinoian glacial time	9000 years
Yarmouth interglacial time	300,000 years
Kansan glacial time	7500 years
Aftonian interglacial time	200,000 years
Nebraskan glacial time	7500 years

The rather unusual discovery of plant remains buried between successive deposits of glacial origin near Toronto was announced by Penhallow 40 years ago, according to Harshberger ('11). Similar remains found elsewhere have led to the conclusion that during the long interglacial periods deciduous forests, similar to those found today farther south, covered much of western New York. Tree species from the forest beds in the vicinity of Toronto include osage orange (*Maclura pomifera*), papaw (*Asimina triloba*) and blue ash (*Fraxinus quadrangulata*).

It seems amazing that interglacial beds have not been discovered in more localities. Perhaps this may be taken as evidence of the destructive effects of subsequent glaciation. It is usually accidental or incidental that interglacial fossils are exposed by excavations along streams and roads.

Buried valleys in Cattaraugus county are evidence that interglacial streams cut valleys much deeper than the present major streams. As a consequence, divides were lowered and gorges or V-shaped valleys were formed. Relative relief was considerably increased, and this must have been effective in preserving and enlarging habitats for pioneer plants and the more xerophytic species of the region. It seems reasonable that the interglacial deepening of the valleys provided additional pathways for migration of the oak-chestnut forests northward along the ridges from the unglaciated region.

The southern and western sections of the county were drained by the Old Upper Allegheny river, which apparently flowed northward in preglacial times. Its chief tributaries occupied the valleys of Tunungwant creek, Kinzua creek and possibly the Conewango, which originally flowed northward from the higher portion of the plateau in Pennsylvania.

It is problematical where the streams in the northeastern portions of the county emptied during interglacial times. From field observations and study of the topographic sheets, it appears most probable that the drainage was northeastward through Wyoming, Livingston and Monroe counties. It is difficult to determine the interglacial drainage absolutely without recourse to geological research methods which are beyond the scope of the present study. Enormous deposits of glacial drift in the northern townships obscure former drainage lines. Kames and eskers have been built up nearly as high as the Portage escarpment. The old valleys have been filled with outwash from the last two glaciations. The interglacial drainage may be inferred from figure 37 and from the more extensive map of preglacial drainage by Chamberlin and Leverett ('94).

THE LAST GLACIATION AND ITS EFFECTS

The last of the great continental glaciers to cover western New York is known as the Wisconsin, of which several stages of advance and recession have been distinguished by geologists. The maximum extent of the ice is shown by the position of the terminal moraines (figure 38).

When the Wisconsin glacier reached its maximum extent in the eastern states, the northern portion of Cattaraugus county was entirely glaciated. Glacial lakes were formed in all the valleys that drained to the northward, with consequent silting of the valleys. The silts are much in evidence in tributaries to the Allegheny river, in parts of the great Conewango valley, in the East Otto swamp

and the tributaries to Cattaraugus creek near Gowanda. On the soils map these are indicated as silty clay loams. On the vegetation map they are shown as areas originally covered with the White Pine-American Elm Swamp Forest.

Another effect of the last glaciation was the depositing of gravels, sands, boulders and boulder clay in terminal and recessional and

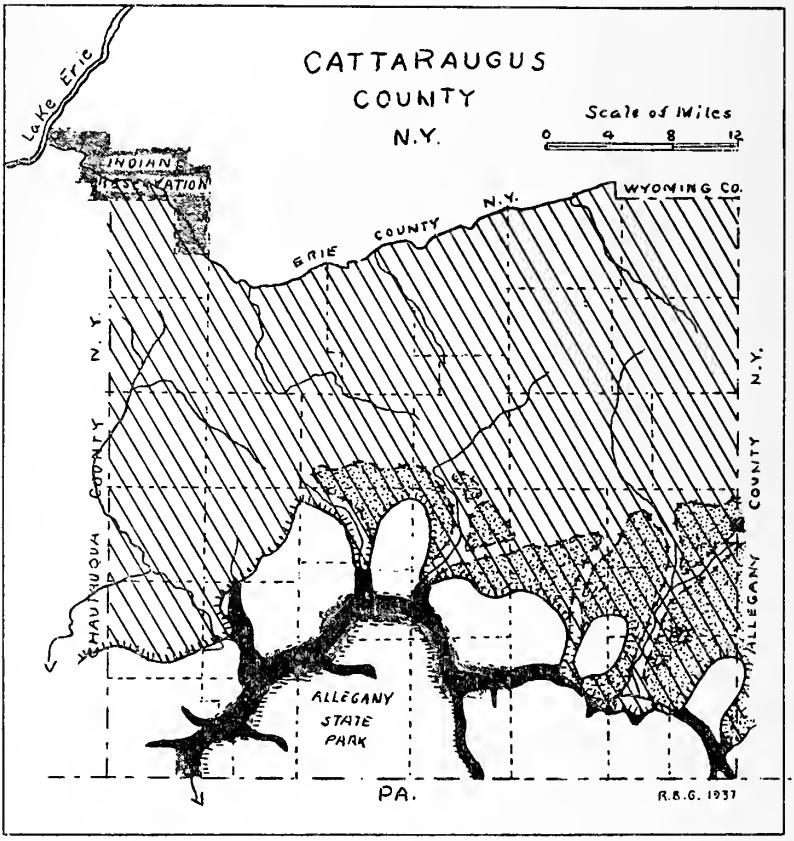

Figure 38 Map showing driftless areas (not shaded) and glacial lake beds (in black). Adapted from Leverett (1902) and Lobeck (1927). Attenuated dr: ft covers stippled areas.

valley loop moraines. These were favorable to the development of sphagnum bogs and alkaline lakes in kettle holes and other depressions. Eskers and kames in the vicinity of Gowanda are among the most striking glacial phenomena of the county. Low hills in the neighborhood of Machias are representative of the modified terrain in the northeastern section of Cattaraugus county. It seems incred-

ible that glacial deposits cover the Portage escarpment near Perrysburg and the plateau south of Randolph at an altitude of more than 2000 feet above sea level. The total thickness of ice at the terminal moraine could not have been much less than 600 feet and may have reached 1000 feet at its maximum thickness.

The most important effect of glaciation, however, was the gouging of interglacial valleys, oversteepening them in some instances, and filling the major valleys with outwash to a considerable depth with presumably slight erosion of the plateau surface. The relative relief of the glaciated portion is rarely over 600 feet, and is generally from 300 to 500 feet (figure 40). In every case where the relative relief is less than 500 feet, the original forest cover appears to have been the Hemlock-Beech and the Beech-Sugar Maple associations. Following the classification of Nichols ('35) both of these were mapped as Hemlock-White Pine-Northern Hardwood Forest. The Hemlock-Beech and Beech-Sugar Maple associations, which contained scattered white pines, represent various local expressions of the climax forest in this region.

MIGRATIONS FOLLOWING THE LAST GLACIATION

Contrary to popular belief, the country south of the terminal moraine was only slightly affected by the proximity of the ice sheet. It must be remembered that the ice was melting faster than it was accumulating. It is likely that more cloudy weather prevailed, with more fogs and rains during summer months. Snowfall perhaps was little heavier than at present in Cattaraugus county. The streams of the region discharged a much greater volume of water than at present, and glacial outwash filled the Allegheny River valley. The high terrace north of Onoville is striking evidence of the stream activity in glacial times.

The thickest ice was obviously in the deeper valleys and was the last to melt. As the main body of the glacier melted, long tongues or valley glaciers were left. The position of these ice masses in the valleys is shown in figure 38. Over the valley ice conditions were favorable for tundra vegetation and eventually for forests of tamarack, black spruce and balsam fir. All of these species remain in the region today, occupying valley bogs throughout the county and the glacial moraine bogs north of Steamburg, between Randolph and Little Valley (figures 9–12, 24, 26 and 27).

Conditions for forest establishment were certainly as favorable in Cattaraugus county following glaciation as they are today in the northern Adirondacks. A mixed forest of hemlock, spruce, balsam fir, beech and sugar maple soon covered the moraines and hills of low relief. The undergrowth of ferns, club mosses and wild flowers in the virgin hemlock forests of Cattaraugus county today is in places identical to that which occurs in the Spruce-Hemlock-Yellow Birch forests of the Adirondacks (Bray, '30, p. 166–71; Heimburger, '34).

The early postglacial forests probably contained much of the fauna (birds, mammals, insects etc.) now found in northern New York, besides some forms, such as the hairy mammoth and giant beaver, which are now extinct. Only a few years ago, in May 1934, the bones of a mammoth were discovered in a swamp near Randolph (Adams, '36).

EFFECTS OF THE XEROTHERMIC PERIOD

Evidence from plant distribution in the Middle West and from pollen analyses of bogs located within the Prairie Peninsula has led to the conclusion that thousands of years following the disappearance of glacial ice there occurred a prolonged period of deficient rainfall, which may have lasted for a couple of centuries. This has been named the "Xerothermic period" or the "Xeric period" (Gleason, '22; Sears, '32; Transeau, '35). Attempts to date the Xeric period place it between 1400 and 1200 B. C. A more severe dry period occurred about 650 A. D. A later period of drought (probably not quite so extensive nor so severe) reached its worst in the thirteenth century (Huntington, '24, p. 319). The effects of such climatic changes, of course, was to bring about death and destruction to mesophytes and hydrophytes, favoring the spread of xerophytes from the western prairies and plains.

In western New York there was an extension of oak openings and a migration of prairie species into Erie, Niagara, Orleans, Genesee, Monroe and even Chautauqua and Cattaraugus counties. Survivors of this migration are found today on shallow soils over limestone. in open marl swamps, on sand dunes, eskers and outwash plains. No true prairies exist in Cattaraugus county at the present time, unless we regard the Calamagrostis Marsh Meadow as a kind of wet prairie.

Of the species which Shimek ('11) regarded as typical prairie plants of Iowa, the following (nearly 85 species, or about 10 per cent of the flora) are known from Cattaraugus county:

Achillea millefolium
Agrostis alba
Allium canadense
Ambrosia artemesiifolia
Ambrosia trifida
Anemone canadensis
Antennaria neodioica
Antennaria plantaginifolia
Apocynum androsaemifolium
Apocynum cannabinum
Asclepias incarnata
Asclepias syriaca
Aster laevis
Aster novae-angliae
Carex cephalophora
Carex pennsylvanica
Ceanothus americanus
Comandra umbellata
Convolvulus sepium
Desmodium canadense
Elymus canadensis
***Equisetum arvense*
Equisetum hyemale
Erigeron canadense
Erigeron ramosus
**Euphorbia maculata*
Fragaria virginiana
Galium boreale
Hedeoma pulegioides
**Hordeum jubatum*
Juncus tenuis
Lactuca canadensis
****Lactuca scariola*
Lepidium apetalum
Lespedeza capitata
Lilium philadelphicum
Lobelia spicata
****Melilotus alba*
Monarda mollis
****Nepeta cataria*
Oenothera biennis
****Panicum capillare*
Panicum virgatum
Pedicularis canadensis
Plantago rugelii
**Poa compressa*
**Poa pratensis*
Polygala sanguinea
Polygala verticillata
Potentilla arguta
Potentilla canadensis
Potentilla monspeliensis
Rhus glabra
Rhus toxicodendron
Rubus occidentalis
**Rudbeckia hirta*
****Rumex acetosella*
****Rumex crispus*
Salix humilis
Scrophularia leporina
****Setaria viridis*
**Silene antirrhina*
Silene stellata
Smilacina stellata
**Solanum carolinense*
Solidago canadensis
Solidago graminifolia
Solidago nemoralis
Solidago serotina
Specularia perfoliata
Taenidia integerrima
****Taraxacum officinale*
Teucrium canadense
**Trifolium repens*
****Verbascum thapsus*
Verbena hastata
Veronica virginica
Viola palmata
Viola papilionacea
Vitis vulpina
Xanthium commune
Zizia aurea

* Introduced in western New York
** Introduced in Iowa.
*** Introduced in both places.

Several of the above plants will be recognized immediately as weedy species and adventives that have been transported widely by man and his vehicles. The rest are "prairie border" species, limited to the lower valleys, along the Conewango and Allegheny rivers. Several have been collected only from a limited portion of the Allegany Indian Reservation between Steamburg and Quaker Bridge, and on river terraces south of Quaker Bridge, near Elko.

It can scarcely be doubted that clearing of the primeval forest, burning of the woods by the Indians and establishment of artificial prairies (meadows and pastures) have been favorable to the prairie plants. A considerable number were undoubtedly native to the southwestern portion of the county at the time of the first white settlement.

Not only the prairies, but oak forests as well (oak-hickory and oak-chestnut types) became more widespread in their distribution during the Xeric period. There must have been a corresponding shrinkage of the areas occupied by the Hemlock-White Pine-Northern Hardwood Forest. The vegetation of shallow bogs was destroyed and replaced eventually by marsh meadows, buttonbush, alder and willow thickets. Deeper peat deposits apparently never dried out completely since the last glaciation, and it is in such places that Cassandra bogs with tamarack, black spruce and balsam fir are found today.

THE MAJOR VEGETATION AREAS OF CATTARAUGUS COUNTY

Although eight major vegetation types have been distinguished and described in this bulletin, there are doubtless several others that were local and did cover small areas. The vegetation map printed in colors and included with this report shows the distribution of the Mixed Mesophytic Forest, the Oak-Chestnut Forest, the Hemlock-White Pine-Northern Hardwood Forest, including the Beech-Sugar Maple Association and the White Pine-American Elm Swamp Forest with the Tamarack-Black Spruce Forest of acid bogs. A smaller map in black and white (figure 39) is introduced for comparison with other maps to the same scale.

It can readily be seen that extending for a distance of about ten miles from the Allegheny river the hills were covered with the Mixed Mesophytic and Oak-Chestnut Forest types. The valleys and lower slopes were generally covered with forests of the Hemlock-Beech and Beech-Sugar Maple type, containing some white pine.

The major control of the natural vegetation of the county appears to be relative relief. The greatest relative relief is exhibited in the southern portion of the county in the townships bordering the Allegheny river, as shown in figure 40. A comparison with the small-scale vegetation map will show here the greatest extent of the Mixed Mesophytic Forest.

SOILS IN RELATION TO NATURAL VEGETATION

The natural vegetation of a region has come to be regarded as the best expression of the influence of physical factors of the environment. In recent years it has been shown that soil profiles also express the results of complex influences that have acted over a long

period of time. Such being the case, we should expect a high degree of correlation between the soil conditions and the plant covering. These correlations have only been suggested in the discussion of zonation and succession of plant communities.

No detailed soils map of the county has yet been published. Few generalized soils maps are available, one in the Atlas of American

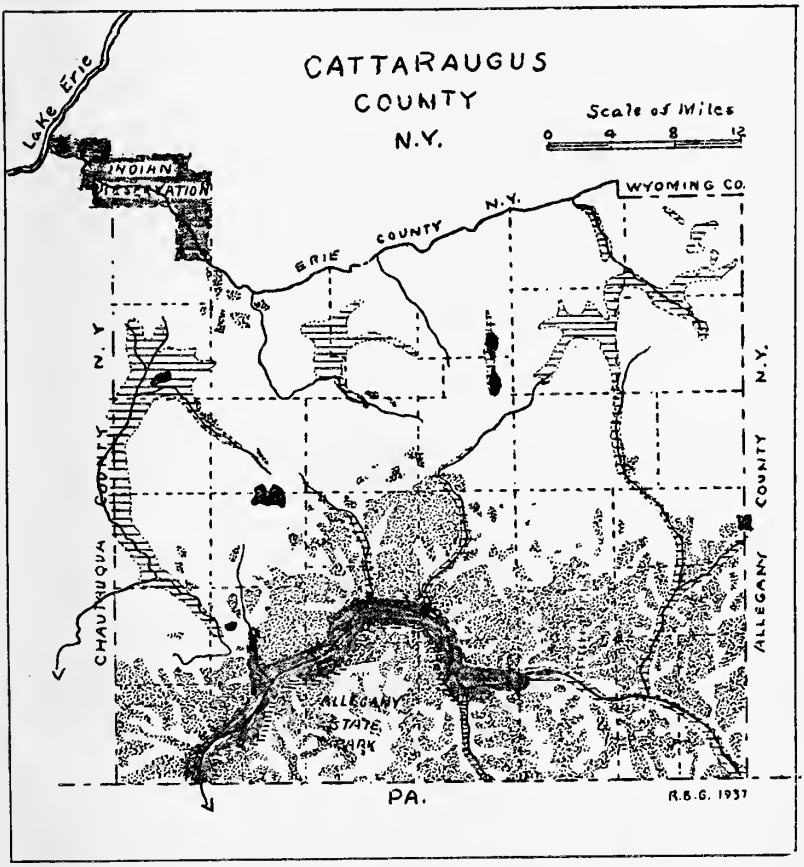

Figure 39 Generalized vegetation map of Cattaraugus county, N. Y. Tamarack-Black Spruce bog forests in black, areas exaggerated; White Pine-American Elm swamp forests shown by horizontal rulings; Mixed Mesophytic and Oak-Chestnut-White Pine forests shown by stippling; Hemlock-White Pine-Northern Hardwood Forest unshaded.

Agriculture (Marbut, '35) and the other in a bulletin on the classification of New York soils (Howe, '35). The two maps show little correspondence in the names of the series recognized, and yet with the series descriptions it is possible in either case to obtain a fair notion of the distribution of major soil areas in the county.

Detailed soils maps are now available for Chautauqua county to the west and Erie county to the north. Field work on the soils survey of Cattaraugus county was completed by Jay C. Bryant and party in 1935. Detailed results of this survey are awaiting publication.

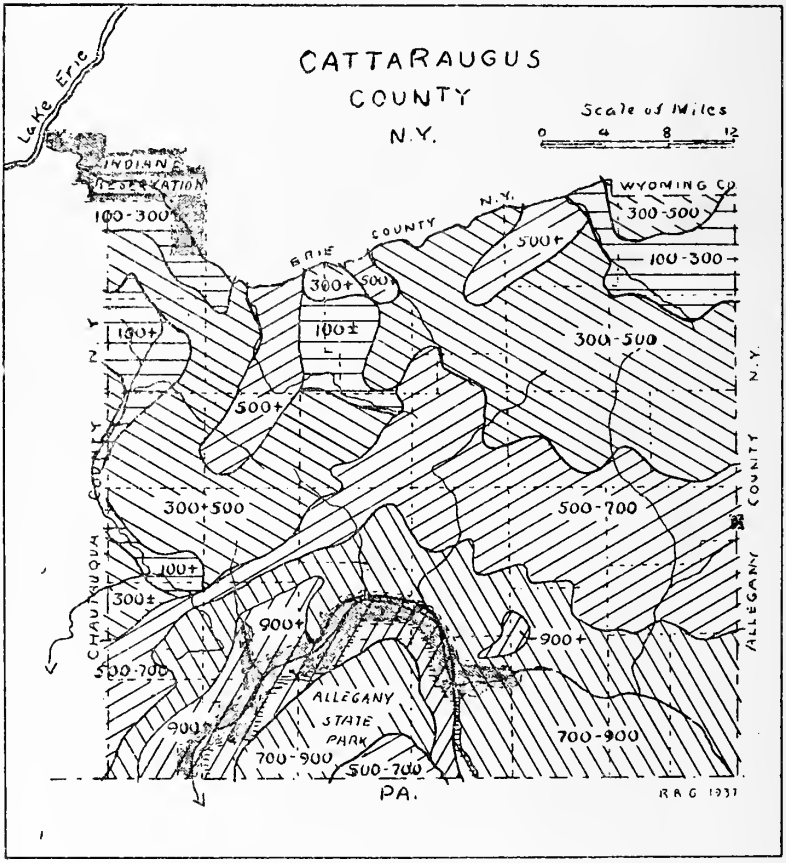

Figure 40 Relative relief as shown by vertical difference in feet, Cattaraugus county, N. Y. Note increased relief in southern portion.

The accompanying map (figure 41) shows the distribution of the principal soil series, furnished by courtesy of C. S. Pearson, assistant soil surveyor in the Department of Agronomy at the State College of Agriculture. It is based on the field sheets of the recent soil survey of Cattaraugus county and is more accurate than the small map in the bulletin on New York soils.

PODZOLS

The unglaciated southern portion of the county bordering on the Allegheny River valley is recognized as an area of DeKalb soils with a large amount of unclassified rough broken land. The older soils in this region show definite evidence of podzolization. That is, the "A" horizon, beneath the humus layer, is ashy gray in color, due to prolonged leaching of the common earth minerals, such as iron and aluminum compounds, leaving mainly silica, which is highly insoluble. The survey of the podzolized soils of the unglaciated plateau in Cattaraugus county disclosed some of the series found on the East Tionesta tract in northwestern Pennsylvania, namely the DeKalb and the Tionesta (Hough, '36). Several phases of the DeKalb are recognized, including a flaggy thin phase on long narrow ridge tops, also a steep phase and a boulder phase. Poorly drained heavy and highly mottled soils associated with the DeKalb series have been mapped as Lickdale silty clay loam (correlated as Ernest silty clay loam). A steep phase, better drained phase and boulder phases of the Lickdale series are recognized in the detailed soils map of this area.

OTHER UPLAND SOILS

The prevailing upland soils in the glaciated northern portion of Cattaraugus county are in the Volusia, Erie, Lordstown, Wooster and Canfield series.

The Volusia silt loam has a characteristically gray surface with a compact, hard, highly mottled subsoil at depths of 2–12 inches. It has weathered from glacial till derived chiefly from local shale and sandstone rocks and is strongly acid in reaction. The Erie silt loam is similar to the Volusia except that it has an alkaline or calcareous subsoil. It may contain some limestone fragments and is more widely distributed in the northwestern and northern portions of the county. The limestone in these soils are entirely of glacial origin, for the most part transported from the Niagara escarpment. Steep phases are recognized in detailed mapping.

The Canfield soils have a gray-brown surface and a yellow-brown subsurface. Mottled, compact subsoil occurs at 18–24 inches. They have imperfect drainage and an acid reaction. Obviously these are somewhat better drained than the Volusia series.

The Lordstown silt loam and stony silt loam are shallow, well-drained and strongly acid. They have a characteristically brown surface, with yellow-brown subsoil resting on bedrock at 24–36 inches.

They may have a thin mantle of glacial till or may be partly residual, consisting entirely of local materials.

The Wooster soils occur mainly in morainic areas and are derived from mixed materials transported by glaciers and glacial waters. Several textures and phases have been mapped in detail. They are well-drained and friable, with brown surface and yellow-brown loose subsoils. No hard pan layer occurs in the soils of the Wooster series.

Some extensive lacustrine soils are found bordering Cattaraugus creek. They have gray or yellow-gray surface, with highly mottled subsurface. The subsoil is composed of cream colored silts and clay, while the lower subsoil is usually of blue clays. Owing to their fine texture they are imperfectly drained, and were mapped in the Caneadea series (correlated as Mahoning). Several phases, including eroded phases, were mapped in detail. Associated dark soils on wet areas associated with the Caneadea were mapped as Granby silty clay loam.

LEGEND

for

Figure 41

Generalized Soils Map of Cattaraugus County

E — *Erie silt loam*
Associated soils — Langford, Lordstown, Chippewa, Hornell, Fremont, Aurora

Vo — *Volusia silt loam*
Associated soils — Canfield, Mardin, Lordstown, Wooster, Chippewa, Hornell, Fremont, rough broken land

Wo — *Wooster gravelly silt loam*
Associated soils — Canfield, Chippewa, Otisville

Mh — *Mahoning silty clay loam*
Associated soils — Toledo, Caneadea

Ca — *Cattaraugus silt loam*
Associated soils — Lordstown

Ch — *Chenango gravelly silt loam*
Associated soils — Tioga, Chagrin, Genesee, Holly, Braceville, Middlebury, Eel, Wayland, Mentor

Fu — *Fulton silty clay loam*
Associated soils — Chenango, Chagrin, Wayland, Eel, Shallow muck

Un — *Unadilla silt loam*
Associated soils — Tioga, Holly, Middlebury; occurring in valleys of the unglaciated region, Pope, well-drained Atkins, poorly drained Tyler, poorly drained terraces

De — *Dekalb silt loam*
Associated soils — Ernest, Hornell, Rough broken land

Le — *Leetonia sandy loam*

BOTTOM SOILS

Along the Allegheny river are well-drained terraces, with strongly acid yellow-brown or rusty brown surface soils. The sediments are usually three to five feet in depth and are derived mostly from upland residue. The lower subsoils are often stratified sand or gravel with foreign materials such as limestone. Such soils were classified in the Wheeling series (correlated as Unadilla). Poorly drained terraces may be associated with the Unadilla series.

Tributaries to the Allegheny river and to Cattaraugus creek also have deep, well-drained terraces, in which the sediments come from glaciated uplands. These are in many respects similar to the Wheel-

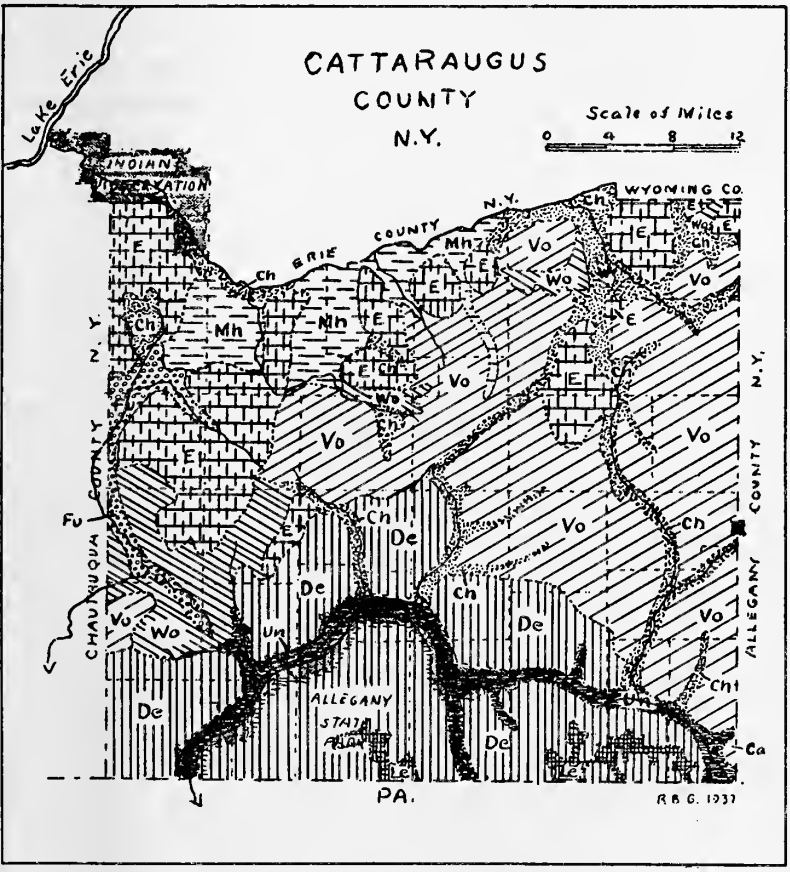

Figure 41 Generalized soils map of Cattaraugus county, N. Y., showing the major soil divisions. For explanation see legend on opposite page and descriptions in text. Courtesy of C. S. Pearson.

ing series, but are regionally distinguished as belonging to the Chenango series. Various textures, ranging from silt loam to gravelly loam, have been recognized in the stream terraces. Imperfectly to poorly drained terrace soils associated with the Chenango series were mapped as Braceville silt loam. This type has a gray surface with subsoil mottled.

The entire Conewango Creek valley is subject to periodic overflow, and yet, because it is a filled valley, all sorts of drainage conditions may be found. Much of the valley is farmed, and the Fulton silty clay loam prevails. Lighter phases are recognized, and the Fulton soils are associated with soils of several other series, of which the Chenango and Chagrin are well drained while the Wayland and Eel series are poorly drained. Shallow muck areas occur near South Dayton. The mapping of such bottomlands offers a considerable problem to the soil surveyor, because of the great variations in texture, color and local drainage conditions. As a matter of fact, alluvial soils are undifferentiated or mapped as "meadow," for practical considerations.

PLANT INDICATORS OF FOREST SOILS

The correlation of soils and natural vegetation has been a much discussed subject. The pedologist has set up a classification of soils into regional soil groups, soil series and soil types. The plant ecologist, on the other hand, has developed a classification of vegetation into regional plant formations, major plant associations and minor plant communities (layer societies) within the plant associations.

In general the Hemlock-White Pine-Northern Hardwood Region corresponds to the region of podzols in eastern North America, while the Eastern Deciduous Forest Region corresponds to the region of gray-brown soils. To correlate the major plant associations with soil series as set up by the soil scientist is not so simple. Cases can be cited where perfect correlations exist and other cases where there is little or no correspondence between the plant associations and the soil series. In as much as the soil series are based on stage of maturity, relative drainage conditions and moisture content there should be good correlation established, because these conditions affect dominance of native plant species. But when the difference between two series of soils is based on whether the soils are outside the glacial boundary, or within the glacial boundary and covered with a thin mantle of drift, there can be no such correlation

established. With the data of the recent soil survey available, it is possible to point out specific cases where good correlation may exist between native forest vegetation and upland soil types in Cattaraugus county. A difficulty is encountered when some of the forested areas are mapped as "rough broken land."

The deepest podzols belong to the Tionesta series. Originally these soils were covered with a forest of hemlock, white pine, red maple, chestnut, cherry birch and cucumber tree. They occur on the highest parts of the plateau, where soils are derived chiefly from massive conglomerates and sandstones.

The DeKalb series are also podzolized, and over most of the area were covered with the climax forest of the Hemlock-Beech type. The presence of yellow birch, blue beech and American elm in a hemlock forest generally indicates poor internal drainage conditions, with the water table fairly close to the surface at all times. The poorly drained, heavy and highly mottled soils associated with the DeKalb series are mapped as Lickdale (correlated as Ernest).

The presence of both red oak and basswood in a forest of the Beech-Sugar Maple type indicates usually fair to good internal drainage. The flaggy thin phase of the DeKalb silt loam is presumably well drained. It may support forests of the Mixed Mesophytic type, with some chestnut, red oak, cherry birch, yellow poplar, white pine and black cherry. Steep phases and boulder phases vary in forest cover, depending on exposure and relative relief.

The soil-forming process of podzolization has been largely responsible for the characteristics of the widely distributed Volusia soils in the glaciated portion of the county. The climatic climax forest on these gray soils was composed largely of hemlock, beech, sugar maple, yellow birch, basswood and white pine. The gray-brown Canfield soils are somewhat better drained and this feature is reflected by increased abundance of sugar maple, basswood, white ash, hop hornbeam and black cherry. The well-drained Lordstown soils are generally brown in color, but may have a similar forest cover, with red oak, pignut hickory, cucumber tree and chestnut as possible members of the forest community.

In morainal areas, the best drained soils are brown in color and belong to the Wooster series. On such sites the hardwoods attain dominance, while hemlock and white pine are scarce or absent from the dominant stand.

On lacustrine soils of fine texture and imperfect drainage, American elm, swamp white oak and beech are favored. Eroded phases

support Beech-Sugar Maple forests. Associated dark soils are indicated by the White Pine-American Elm type with an undergrowth of hemlock, yellow birch, black ash, red maple and balsam fir.

GENERALIZED SUGGESTIONS FOR A LAND USE POLICY

NEED FOR IMPROVED LAND USE

According to the report of the New York State Planning Board (A. R. Mann, Chairman, '35), Cattaraugus county is but one of the many counties in New York with more than half of its area in submarginal farmlands and other lands of which no use is being made. At present the landowners can not carry their share of public expenses for schools, road-building, bridges and other public services. It was recommended that about three-fourths of such lands should eventually be acquired by the State. The State has probably paid for the land already in the form of aid to schools, road-building and rural extension services in this county.

There may be local objections to further increase of state-owned land in Cattaraugus county, but the establishment of the Allegany State Park in 1921 has certainly proved a boon to the economic situation in the county in more than one way. The abandonment of farms, the decrease in rural population and the diminished timber resources bear abundant testimony to the fact that a more conservative policy of land use is imperative (Adams, '37).

Since the administration of Theodore Roosevelt as President of the United States, there has been a growing number of governmental agencies concerned with conservation of our natural resources, which are the true source of the Nation's wealth. Some resources exist in such enormous quantities that they can be depended upon for ages to come. In this class are solar energy, oxygen, nitrogen, carbon dioxide, water vapor, water power, fresh water and salt water, building stone, clays, sands and aggregates. Other resources are less dependable and apparently irreplaceable, such as coal and metallic ores of high grade, petroleum, natural gas and topsoils. Still other resources can be replaced at the expense of much human ingenuity and effort. Replaceable items include forests, grasslands, wild life and certain mineral nutrients in the soil, particularly nitrates and phosphates.

There is much published material available as to how to improve our forests, grazing land, farmlands and supply of native wild-life, but the factors that are lacking in most cases are human effort and

ingenuity required to increase productiveness as much as possible under existing conditions of soil and climate.

There is no doubt that Cattaraugus county is well suited for dairying, forestry and rural recreation. The short growing season in the southern townships makes hazardous the production of field crops. Long-season crops of course are not adapted to this climate, where the average length of the growing season is between 110 and 130 days, where nights are likely to be cold, and where frost may occur any month in the year. (Mordoff, '25; Mason, '36; Gordon, '37*a*).

LANDS RECOMMENDED FOR FORESTRY AND WATERSHED PROTECTION

About 50 per cent of Cattaraugus county is covered with forest and idle land, not used for pasture, hay or field crops. Figure 42 shows the extent and distribution of crop lands based on intensity of use, but does not indicate the area devoted to pasture. Approximately one-fifth of the idle land now is property of the State, the largest area of this kind being the Allegany State Park of some 60,000 acres, south of the Allegheny river. The remaining 40 per cent of the county in forest and idle land is still in private and corporate holdings.

Much of the forested and idle land is too steep for agriculture and should in time be acquired by the State. The Allegany State Park could well be enlarged to include that part of the county south of the Allegheny river and east of the present boundary. This would bring into the park the Olean Rock City, now definitely in need of management as an unusual scenic area of great geologic interest. Once the Rock City was a popular interurban amusement park. The electric railroad and places of amusement have long since been abandoned and are falling into ruin. Parking facilities for vehicles are inadequate, steps and ladders among the rocks are decidedly unsafe, and there are absolutely no sanitary facilities, except those provided at a gasoline station and refreshment stand on the highway near the rocks. Numerous oil pumps are located in the vicinity. Under park management, there would be no interference with oil rights, but the central pumping station should preferably be replaced by individual pumps for each well.

Southwestern Cattaraugus county, including South Valley and the southern part of Randolph township, has certain advantages as a game-producing area. (Cahalane, '28). The remaining unglaciated

and thinly glaciated areas should gradually be retired into state-owned and municipal forests for the benefit of the wood-using industries and for watershed protection. The following townships should contribute great blocks of land for scientific forest management: Napoli, Cold Spring, Little Valley, Salamanca, Great Valley, Humphrey, Ischua, Hindsdale, Allegany, Olean and Portville. Farming and dairying in these townships should be continued and encouraged in suitable areas of low relief.

Cattaraugus county is one of the leading New York counties in the production of maple syrup and maple sugar. One farmer is establishing a grove from a dense stand of second growth sugar maples. "Thinning was first begun about 1909, when the trees were seven years old. When the stand was 25 years old, there were 200 well-developed thrifty maple trees to the acre, averaging more than 25 feet in height and four inches in diameter. Some of the more favored trees will be ready to tap in 1942. By 1947, continued thinnings will reduce the stand to about 100 trees per acre, yielding about 30 gallons of syrup per year." (Collingwood, Cope and Rasmussen, '28).

With careful management of existing sugar bushes and development of unused stands of second growth, maple products could be greatly increased and would provide an income from what is now largely idle land. In Chardon, Ohio, a Maple Festival is held annually to keep alive a distinctively American tradition. Lack of tradition and inadequate advertising of the local product has kept producers in Cattaraugus county from realizing as much as they deserve for a superior product of home industry.

LANDS RECOMMENDED FOR PERMANENT PASTURE

Cattaraugus county, in common with a large part of western New York, has a great amount of glacial soils on rolling topography adapted for hayfields and permanent pastures, essential to dairy farming. On account of the relatively short growing season, winter feed costs have become the limiting factor in the local dairy industry (Mason, '36). The number of cows that can be kept over winter depends on the amount of hay that can be cut and stored during the summer. The timothy hay is frequently of inferior quality, mixed with wild oat grass and unpalatable weeds. This condition can scarcely be remedied without soil improvement and therefore merits discussion. It has been the author's observation that poorest pastures occur in areas originally occupied by the Oak-

Chestnut Forest, and elsewhere on thin, eroded soils. It is a serious question whether any effort should be made to improve such land, except for erosion control. Other poor pastures occur on steep slopes formerly occupied by the Mixed Mesophytic Forest and the Hemlock-Beech Climax Forest. Gentler slopes, less than 20 per cent, have been rather less subject to erosion, before and after the forest was removed, and yield better grass. The "strongest" soils for permanent pastures were originally covered with the Beech-Sugar Maple Forest and the Bottomland Hardwoods. Lower slopes are generally more fertile than upper slopes, due to less severe loss of topsoil through sheet erosion.

Studies by the U. S. Soil Conservation Service have resulted in the general recommendation that permanent pastures be limited to slopes of less than 20 per cent. All slopes in excess of 20 per cent, and badly eroded, broken areas should be retired to forest (Cutler, Paschall and Conrey '37).

Grasses and clovers in a pasture play an extremely important part in erosion control. . . . A dense pasture sward prevents the direct impact of raindrops with the surface soil, thereby lessening their erosive effect and preventing the compaction of the soil. The resistance to the flow of water over the surface caused by the stems and leaves of grasses and clovers allows more time for the absorption of water and reduces the amount of loss by run-off. The fibrous roots added to the surface soil by the growth of grasses and clovers lead to an increased water-holding capacity and greater porosity. . . . Recent experiments at Cornell University indicate that the earthworm population of improved pastures may be several times as great as in unimproved pastures on the same soil. An improved pasture also was found to absorb 89 per cent of a heavy rain, as compared with only 58 per cent by the adjoining unimproved pasture on the same slope (Howe and Adams, '36).

Acid soils prevail generally in Cattaraugus county, and for this reason the growth of clovers and other legumes to improve the soil is generally prevented. The natural soils frequently test around pH5.0 or less, showing that they are from 10 to 20 times as acid as they should be for even good pasture land. As a consequence timothy, wild oat grass, daisies and devil's paint brush grow in the pastures. Bluegrass and Dutch clover would thrive, were the soil acidity reduced to pH 6.0 or 6.5. Two to four tons of agricultural limestone to an acre are required to bring these highly acid soils into a productive state. In fertilizer tests on soil of the Volusia type, which is widely distributed in Cattaraugus county, it was found that it gave as much response to lime as to heavy fertilization without

lime. The addition of lime alone caused the Volusia soil to yield more than the soil of the Ontario type, which is naturally a very productive soil, while the Volusia does not have that reputation (Lyon, '31).

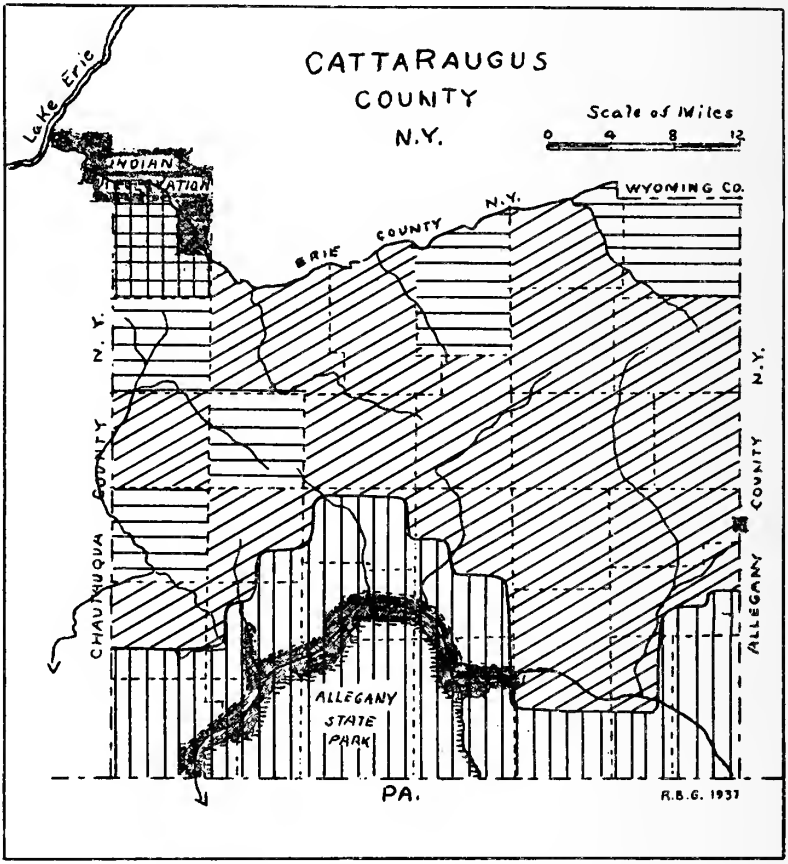

Figure 42 Extent and distribution of cropland based on intensity of use. Adapted from Howe ('34). Vertical rulings indicate 0–15 per cent of land in use; diagonal rulings 16–30 per cent; horizontal rulings 31–45 per cent; cross-rulings 45 per cent or above.

The need for lime is very apparent throughout the county. Although there are no quarries in Cattaraugus county where limestone can be obtained, there is plenty available in counties to the northward. Marl deposits occur in the heavily glaciated areas, but these could be utilized only at the risk of destroying ponds and marshes more valuable for other purposes.

LANDS RECOMMENDED FOR FIELD CROPS

The Seneca Indians have been growing corn, beans, pumpkins and native tobacco (*Nicotiana rustica*) in their gardens on the river terraces perhaps for centuries. The coming of the first European farmers into this section of New York State resulted in increased production of some of the native food plants, but their experience showed that other crops were even better adapted to the climatic

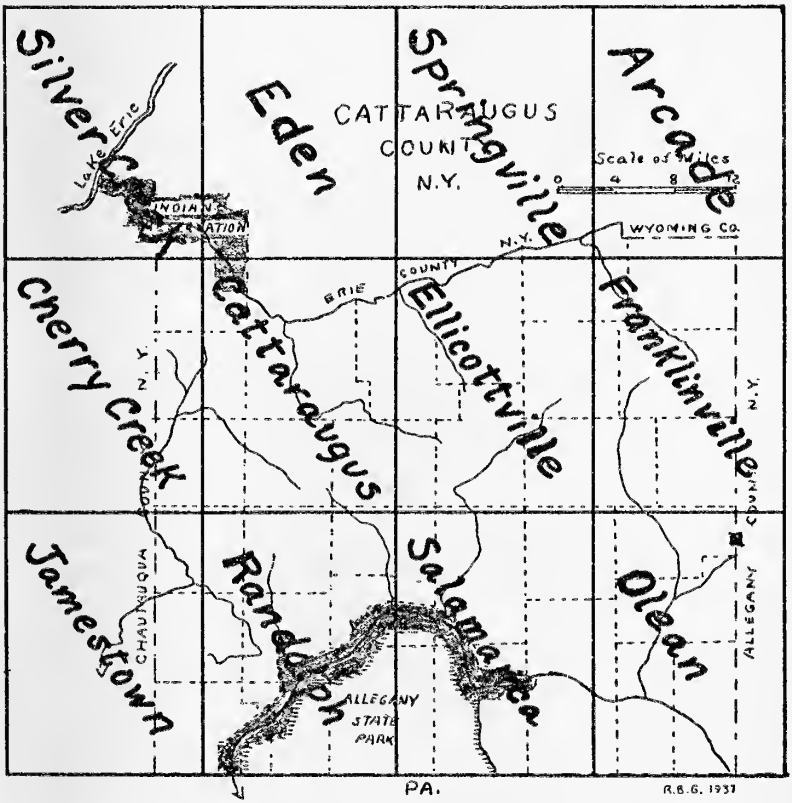

Figure 43 Index to quadrangles of the United States Geological Survey

and soil conditions of the region. The better adapted crops are potatoes, oats, barley and buckwheat. Wheat is rarely grown. Field corn frequently fails to mature, and is then cut for fodder.

Soils belonging to the Langford, Erie and Fulton series are higher in lime than those belonging to the Wooster, Volusia and Chenango series. The Langford, Erie and Fulton series are also more productive, and this is generally true of all soils in New York

State of higher lime content. (Howe, '35). The best farmlands of the region are located in the bottomlands and river terraces. Only slopes less than 12 per cent, preferably less than 8 per cent, should be used for field crops. Due to the great danger of erosion, every precaution should be taken to prevent loss of valuable top soil.

There is considerable need for soil improvement, even on the better farms. Adequate liming should receive first consideration. Two tons of agricultural limestone to an acre may not be adequate. Contour plowing and furrowing is necessary on slopes to prevent sheet wash. Strip-cropping is another excellent scheme to save the surface soil. One reason why some farmers have had to add lime to the soil every few years may be the loss of base-saturated top soils through sheet erosion. A rotation of corn one year, oats or mixed oats and barley one year, clover and timothy two years, can usually be depended upon to maintain average fertility levels. Alfalfa may profitably be grown on gravelly soils, but is not advised for soils of heavy texture. Lime and soil inoculation should precede planting of alfalfa to insure a successful crop.

SUMMARY OF RECOMMENDATIONS

1 The State should gradually acquire about one-third of the lands in the county for the purpose of forestry and rural types of recreation. Specifically the Allegany State Park should be enlarged to include the area east of the park, bounded by the Allegany Indian Reservation, the Allegheny river and the Pennsylvania state line. This will bring into the park a place of great scenic value, the Rock City south of Olean.

2 Conservative management of existing sugar bush and development of unused stands of second-growth sugar maple may be depended upon to increase production of maple sugar. This must be coupled with a cooperative effort to advertise Cattaraugus county maple products, to increase demand for a local commodity with a distinctively American flavor.

3 Slopes greater than 20 per cent should be retired to forest, slopes of 8 to 20 per cent may be used for permanent pasture, but should be improved by the addition of limestone at the rate of two to four tons to an acre.

4 No slopes greater than 12 per cent, and preferably slopes less than 8 per cent, should be devoted to field crops. Even the better farms can be improved by strip-cropping, contour plowing and liming, with an adequate rotation to maintain fertility levels.

SOCIAL ADJUSTMENTS

Among the social changes to be expected in the near future is an influx of foreign-born citizens from industrial centers to the idle farmlands of Cattaraugus county. The immigrants will take over abandoned farms in this region and may be expected to improve them. Beneficial results will follow superior farm management practices, such as strip-cropping, liming, contour-plowing and other recommendations of the State College of Agriculture and the Soil Conservation Service. In many cases, success of the new generation of farmers will be attributed to long hours of work. The whole family cooperates to cultivate the fields. Human effort, reinforced by human ingenuity, may be expected to increase productiveness of the soils in Cattaraugus county, and thus add to the real wealth of the community.

Centralization of schools should provide a more efficient educational system than the one-room schoolhouses with one teacher and few pupils. The teaching of vocational agriculture and home economics should be broadened to meet the needs of what is essentially a rural community. Fundamentals of farm forestry and wild life management must be added to the vocational agriculture courses. The writer is convinced that the whole county would be much wealthier today if an intensive program of rural education to meet the needs of the community had started 20 years ago, when the Smith-Hughes act became effective.

SUGGESTIONS FOR BOTANICAL FIELD EXCURSIONS

1 WATERMAN SWAMP NEAR LITTLE VALLEY

The largest and best preserved area of bog vegetation in the county is located about three miles west of Little Valley, the county seat. On the topographic map of the Cattaraugus quadrangle, it is named Waterman swamp. From Salamanca, follow State Route 18 north through Little Valley. About two miles beyond the center of town is a crossroads called Champlain Corners. Leave Route 18 here and follow the paved county road to the left, or southwest. This road follows Little Valley creek to its headwaters in Waterman swamp, which extends to the roadside. At the first farm beyond this point, permission should be obtained to enter a lane through a pasture which lies south of the swamp (WS-figure 44).

Be sure to take a compass with you and plan to spend two or three hours at least, since it is not easy traveling. Fallen spruce trees knee high or waist high in some places obstruct the trails through

swamp forest and bog shrubs. Elsewhere rhododendron thickets present an obstacle to travel. If you strike out north through the swamp, you will soon reach the Black Spruce-Tamarack zone. In the center of the bog is an extensive Cassandra heath with scattered dwarf conifers (figure 11). Numerous deer trails cross the bog and these are naturally chosen by berry pickers and other pedestrians.

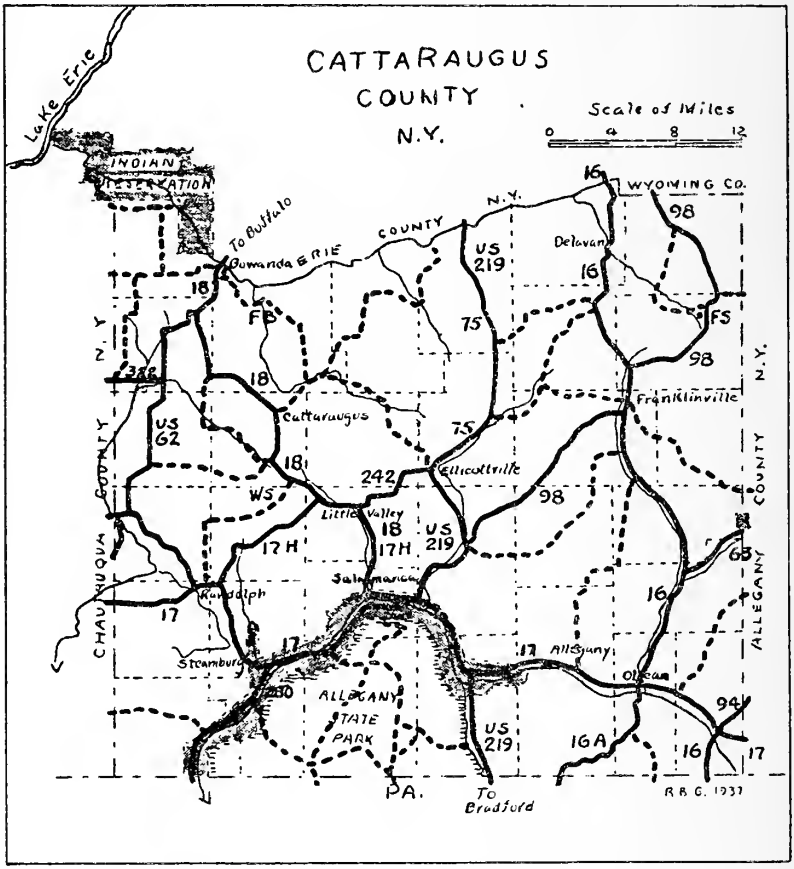

Figure 44 Highway map of Cattaraugus county, N. Y. Solid lines indicate state and federal highways. Dotted lines indicate secondary routes. Abbreviations: FB–Forty Bridge; FS–Farmersville Station; WS–Waterman swamp; US–Federal highway.

A small pond lies in the southwest portion of the bog (figure 12). It is not easy to find, but some of the deer trails run in that general direction. On leaving the bog, head south as directly as possible. This will bring you eventually to the lane, by which you can retrace your steps to the place where you parked your car. Figure 28 shows a transect from the pond to the climax forest. It is drawn to scale

horizontally and indicates the vegetation zones you may expect to pass through. It will be instructive to carry a stout staff or a soil augur with you to poke into the bog peat at various places.

2 THE POND AT FARMERSVILLE STATION

This pond is conveniently located on New York State Route 98 between Farmersville and Crystal Lake. As shown in figures 25 and 29, it is bordered by a zone of tall shrubs, including alders, buttonbush and willows, which is in turn surrounded by an extensive marsh meadow dominated by *Calamagrostis* and *Carex*. The pond is one of many little lakes distributed in the northeastern townships. Well-known to botanists of Buffalo and vicinity is Lime lake at Machias, with an extensive swamp at the south end (Zenkert, '34). Scout Haven, a Boy Scout reservation, is located at Crystal lake. Near Elton is Beaver lake, an alkaline body of water with a marl bottom. Small areas of marsh meadow and swamp shrubs occur here, but in general the vegetation zones have been considerably disturbed.

3 THE SHALE RAVINE AT FORTY BRIDGE

For a study of vegetation on eroding shales and early stages of succession in a flood plain, an excursion to Forty Bridge is recommended. The steep-walled gorge of the South Branch of Cattaraugus creek offers spectacular scenery, making this a popular place for picnics and overnight camping.

From Gowanda follow the Brooklyn road south, ascending a steep grade to a large gravel pit on the right. Shortly after sighting the gravel pit at the top of the grade, you will find a dirt road to the left. Turn sharply and follow it down grade, crossing Point Peter creek, over eskers and kame-eskers for about two miles, passing other dirt road intersections. The next bridge, across the South Branch, is known locally as Forty Bridge. Do not cross the creek, but park your car on this side, out of the road. Then you can proceed on foot up the left bank of the stream. If the creek is not too high you can wade or cross on stepping stones to the flood plain on the other side. There is a considerable variety of plant life in this small area. The scenery alone is worth a brief visit.

4 MIXED MESOPHYTIC FOREST ON JONES HILL

From Steamburg, on New York Route 17, a dirt road leads south to an abandoned dairy farm, then turns right, then left and up a steep grade for about a mile to the top of Jones hill. A splendid

view of the surrounding country can be obtained from the summit toward the glaciated country to the north and the unglaciated country to the east and southeast. There is no satisfactory place to stop a car on the grade, except at an abandoned farm nearly half-way to the top of the hill. For an auto caravan, it may be better to park in the farmyard at the foot of the hill and hike to the top. The forest on the hillside has been cut over, but in such a way that its composition is not greatly changed. The undergrowth is perhaps just as natural as ever in much of the wooded portion.

The base of the hill contains remnants of the Hemlock-Beech Association with sugar maple, yellow birch, white ash, basswood and black cherry. About a fourth of the way to the summit of the hill, a change appears in the forest composition. Red oak, chestnut and black birch enter the mixture and yellow birch becomes less important or drops out. This marks the lower boundary of the Mixed Mesophytic Forest. A decided change in the undergrowth is observable, also. For composition and characteristic plants, see pages 37–38. Just below the summit of Jones hill, you can observe a remnant of the Oak-Chestnut Forest, extending about one-fourth of the way down, indicated by the presence of a large proportion of chestnut and some chestnut oak. White pine stumps and living trees of the same species indicate its presence in all of the forest types from the base to the summit of the hill.

5 SECONDARY OAK FOREST AT RED HOUSE

In the recent vegetational survey of Cattaraugus county no remnant of the original Oak-Chestnut Forest could be found. This is only to be expected because of the great commercial value of white pine, oaks, chestnut and hickory, which enter into its composition. All of the oak forests found today are secondary, following lumbering and fires. Ease of access and variety of the flora were the criteria used in selecting the Oak Forest at Red House as the objective for a botanical field excursion.

To reach the Oak Forest, use the Red House entrance to the Allegany State Park, following the paved road for about one mile, passing the little Balsam swamp in a field on the left, and watching for the first dirt road to the left and leading south. This is the west entrance to the C. C. C. camp (S. P. 51) and continues up-grade as a narrow truck trail into the Experimental Forest belonging to the New York State College of Forestry. It would not be advisable to drive a car up the trail, so cars should be parked near the C. C. C.

camp. A short walk, scarcely a quarter of a mile, will bring the pedestrian into the midst of the Oak Forest, which continues to the top of the ridge about a mile farther south. Silvicultural experiments are being conducted here and visitors are urged to use special precautions to prevent forest fires. For a list of the species important in this type of forest refer to pages 36, 37 and 38 of this bulletin.

6 THE CLIMAX FOREST IN BIG BASIN

No more extensive area of the Hemlock-Hardwood Forest can be found in Cattaraugus county than the 1800-acre tract in the Allegany State Park known locally as the Big Basin. (Emerson, '37). To reach it, follow State Route 17 to Red House and turn east on the concrete road to the Allegany State Park. On reaching the artificial lake, turn right and cross the bridge-dam to the Administration Building, where cars can be parked. Inquire about the Big Basin hiking trail which starts here. In less than a half-mile walk, you will enter a forest of big trees. The trail is about four and one-half miles long, but it is not necessary to go more than a mile and a half or two miles to see what the forest is like. Note the dominance of hemlock, beech, yellow birch and sugar maple, especially near the brook. Associated trees of other species may be observed. The undergrowth in summer is composed almost entirely of wood ferns, shining club moss, white wood sorrel, yellow clintonia and Canada mayflower. Ascending the slopes, you will observe a gradual decrease in hemlock and yellow birch, as well as a corresponding increase in beech, sugar maple, basswood and white ash as you climb out of the valley of Stoddard brook. Do not cross the ridge, but return to your trail by traveling down hill. If you do not care to walk, you can see a part of the forest in driving over the English-Stoddard road which has been cut through Big Basin intersecting the old Bay State road at the top of the ridge.

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Figure 45
Map Showing
Natural Vegetation Areas
of
Cattaraugus County, New York

LEGEND

HEMLOCK, WHITE PINE-NORTHERN HARDWOOD FOREST (BEECH, YELLOW BIRCH, SUGAR MAPLE, BASSWOOD, ETC.)

WHITE PINE, AMERICAN ELM, ASH FOREST (INCLUDING SMALL AREAS OF TAMARACK BLACK SPRUCE BOG FOREST)

MIXED MESOPHYTIC FOREST AND VARIANTS

OAK-CHESTNUT FOREST AND VARIANTS

NATURAL VEGETATION AREAS OF CATTARAUGUS COUNTY, NEW YORK

Scale 1:250,000

1 0 2 4 6 8 Miles

Contour interval 20 feet